



Memorandum

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*From: Frank Tsang and Scott Kirchner
Date: October 13, 2014*

*Subject: 2012 Background Tissue Split Sampling Data Comparison for the Lower
Passaic River Study Area*

At the request of the United State Environmental Protection Agency (EPA) and the United States Army Corps of Engineers (USACE), CDM Federal Programs Corporation (CDM Smith) collected oversight split samples as part of the Lower Passaic River (LPR) Restoration Project remedial investigation conducted by the Cooperating Parties Group (CPG). This memorandum presents the comparison of the EPA oversight team's split sample results to the CPG's sample results and discusses the differences in the data pairs. In this document, samples are referred to as either CPG samples or EPA split samples for clarity.

The split sample comparison consisted of 11 split sample pairs, which were evaluated for dioxins/furans, pesticides, polychlorinated biphenyls (PCBs), polycyclic aromatic hydrocarbons (PAHs), total extractable lipids, and metals. All of the EPA and CPG split sample pairs are comparable except the following:

- Pesticides: 2,4'-dichlorodiphenyldichloroethane (2,4'-DDD), 2,4'-dichlorodiphenyldichloroethylene (2,4'-DDE), and 2,4'-dichlorodiphenyltrichloroethane (2,4'-DDT)
- PAHs: anthracene and naphthalene
- Metals: arsenic, cadmium, lead, and mercury

Oversight Program

Oversight was conducted in accordance with the CDM Smith 2010 Final Quality Assurance Project Plan (QAPP), Addendum No. 5, Fish Tissue Analysis. Eleven tissue split sample pairs were collected above Dundee Dam.

Data Comparison Methodology

The CPG and EPA split sample data were evaluated for potential differences by plotting the selected analytes listed on Table 1. For each of the following three plots, data are plotted on the figures and evaluated only for the cases where both sample pairs are detected.

- **Line Plot:** The concentrations measured by both analytical programs for the detected paired samples were plotted against the same axes. The graph depicts the relative magnitudes and patterns of concentrations.
- **Bivariate Scatter Plot:** CPG sample concentration was plotted as a function of EPA sample concentration for each detected pair. The bivariate scatter plot illustrates the relationship between EPA and CPG data. Also included on the graph is a line which depicts a 1:1 ratio of concentration of EPA and CPG sample. The bivariate plot can be used to identify potential systematic bias when data points fall consistently above or below the 1:1 line.
- **Percent Difference Plot:** The percent difference (%D) was defined as the difference between concentrations for detected data pairs, divided by the concentration of the EPA sample (Equation 1).

$$\% D = \frac{(R_{EPA} - R_{CPG})}{(R_{EPA})} (100) \quad \text{(Equation 1)}$$

Consequently, a negative %D indicates a CPG result that is higher than the EPA result, while a positive %D indicates a CPG result that is lower than the EPA result. This plot provides a visual indication of the extent of positive and negative differences between the two data pairs. The red dashed lines on the plot correspond to the criteria of 40%D and -67%D. These criteria correspond to 50% relative percent difference (RPD) (CPG's field duplicate acceptance criterion), converted to %D values. The %D term is commonly used when one of the two values is known or accepted, whereas RPD is more commonly used when both values are uncertain. The sample data in this graph was represented with the EPA result as the known value and the CPG result as the unknown value.

In addition to the presentation of data comparison plots in figures, the tests described below were also conducted for CPG and EPA data pairs and presented in Table 1.

- **Average Ratio:** The ratios of the CPG detected results to EPA detected results were calculated for each compound in a sample pair. The average ratio and standard deviation were calculated for each compound in all sample pairs. An average ratio above one indicates that the CPG results were detected higher than the EPA results, while an average ratio below one indicates that the CPG results were detected lower than the EPA results.
- **Percent Difference:** The calculated %D values were evaluated against the acceptance criteria of greater than or equal to -67%, or less than or equal to 40% (equivalent to less than or equal to 50% RPD).

- Statistical Test: The statistical tests were performed to calculate p -values. The p -value is an indicator of the presence of a difference between the data pairs. A p -value of less than 0.05 indicates a statistically significant difference between the two datasets.
 - Wilcoxon Signed Rank (WSR) Test: The WSR test was used to calculate p -values for all detected sample pairs.
 - Paired Prentice Wilcoxon (PPW) Test: In addition to the WSR test conducted on the detected data pairs, a modified version of the test, the PPW test, was also conducted to allow inclusion of the left-censored (nondetected) data pairs. The elimination of data pairs containing nondetected values is essentially equivalent to ignoring potentially substantial information contained within these nondetect-containing data pairs, and may lead to biased results. The PPW test relies on survival analysis computations as detailed in O'Brien and Fleming (1987) and is considered the standard test for the case of censored matched pairs (Helsel 2005).

The data comparison plots are depicted in Figures 1 through 48. Results for the three comparison criteria (average ratio, %D, and statistical tests) are presented in Table 1. The numbers of split sample pairs are listed for each compound along with the number of pairs which had detected results for both samples. The average ratio of results of CPG sample to those of EPA sample results are reported with the standard deviation of the ratios. The %D results are summarized by reporting the percentage of data pairs that exceeded the acceptance criteria (40% and -67%). Also included are the p -values calculated by the WSR test and the PPW test.

An overall evaluation of the split sample data is based on the result of the three comparison criteria, where each compound has a rating of "Same" or "Different". The data pairs are considered comparable or "Same" if at least two of the three criteria are met. The comparison criteria for each compound are listed below.

- Average Ratio: Average ratio of CPG to EPA results within 0.70 to 1.30.
- Percent Difference: Less than 16% of the data pairs exceed the acceptance criterion of -67% to 40%.
- Statistical Test (WSR Test and PPW Test): p -Values greater than or equal to 0.05 are within acceptance limits, indicating that there is no significant statistical difference between the datasets. When WSR test and PPW test draw different conclusions, the conclusions of PPW test would be used since the PPW test, which includes nondetects, has more power to discern the differences between datasets.

Results of data comparison of CPG and EPA split samples are summarized below and presented in Table 1 and Figures 1 through 48.

Dioxins/Furans

All the seven parameters were considered comparable, and they met all the three comparison criteria, except that 1,2,3,4,6,7,8-Heptachlorodibenzofuran (1,2,3,4,6,7,8-HpCDF) failed to meet %D criterion. All the average ratios ranged from 0.94 to 1.19, which are within the 0.70 to 1.30 criterion, and none of the data pairs was considered statistically different based on WSR test and PPW test. Overall, CPG results were comparable to EPA results.

Pesticides

Among the eight evaluated pesticide compounds, 2,4'-DDD, 2,4'-DDE and 2,4'-DDT were found to be different between EPA and CPG data pairs. The three compounds failed to meet average ratio and %D criteria. Both 2,4'-DDD and 2,4'-DDE had *p*-values less than 0.05 based on both WSR and PPW tests, indicating statistically significant differences between EPA and CPG results. Moreover, 2,4'-DDD and 2,4'-DDE each had 11 detected pairs, where all the CPG results were greater than EPA results. The other pesticide compounds met all the three criteria, except that 4,4'-DDT did not meet average ratio criterion.

Polychlorinated Biphenyls

All the 11 evaluated PCB compounds were considered comparable, and they met all the three comparison criteria, except that PCB 77 was considered statistically different based on PPW test. All the average ratios ranged from 0.91 to 1.07, which are within the 0.70 to 1.30 criterion, and none of the data pairs was outside the %D range. Overall, CPG results were comparable to EPA results.

Polycyclic Aromatic Hydrocarbons

Of the nine evaluated PAH compounds, anthracene and naphthalene were considered different in data pairs. Anthracene met none of the three comparison criteria, and all the CPG anthracene results were higher than EPA results among the 11 detected pairs. Naphthalene met %D criterion, but it had an average ratio greater than upper limit of the criterion (1.30). The data pair of naphthalene was considered statistically different based on PPW test. The other PAH compounds met all the three comparison criteria, except that chrysene failed to meet %D criterion.

Total Extractable Lipids

The results for total extractable lipids were comparable for the two data pairs. Although PPW test suggested statistically significant differences, total extractable lipids met the other two criteria.

Metals

Except for mercury, method 6010 was applied for EPA samples, while method 6020 was used for CPG samples. The different analytical methods might have influenced the discrepancies observed between the split sample results.

Among the 11 evaluated metals, arsenic, cadmium, lead, and mercury were found to be different between CPG and EPA results. Arsenic, cadmium and mercury did not meet any of the three comparison criteria. Lead only met statistical test criterion, and failed to meet the other two criteria. For the other seven metals considered comparable, all the criteria were met, except that copper and zinc did not meet statistical test criteria, and barium did not meet %D criteria.

- Arsenic: For those five detected pairs out of eleven split samples, all the CPG results were smaller than EPA results with %D ranged from 75% to 92% which failed to meet the %D criterion. It also resulted in a small average ratio (0.15). However, all the results, EPA and CPG, were below reporting limits, and it is likely that no conclusion can be drawn on the apparent differences.
- Cadmium: For the four detected pairs, all the CPG results were greater than EPA results by one to nine times. Similar to arsenic, no data pair was within %D range, and cadmium had an average ratio (4.23) greater than the upper limit of the criterion (1.30). However, all the EPA results were below reporting limits, and it is likely that no conclusion can be drawn on the apparent differences.
- Lead: For the five detected pairs, all the CPG results were smaller than EPA results. Two of the five data pairs were not within %D range, and lead had an average ratio (0.68) smaller than the lower limit of the criterion (0.70).
- Mercury: For the 11 detected pairs, all the CPG results were greater than EPA results. Two of the 11 data pairs were not within %D range, and mercury had an average ratio (1.40) greater than the upper limit of the criterion (1.30).

Attachments

Table 1 – Summary of 2012 Lower Passaic River Background Tissue Sampling Comparison

Figures 1 through 48: Statistical Plots

- a. Line Plots
- b. Bivariate Scatter Plots
- c. Percent Differences Plots

- Figures 1 through 7: Plots of Dioxin/Furan Concentrations
- Figures 8 through 15: Plots of Pesticide Concentrations
- Figures 16 through 27: Plots of Polychlorinated Biphenyl Concentrations
- Figures 28 through 36: Plots of Polycyclic Aromatic Hydrocarbon Concentrations
- Figure 37: Plots of Total Extractable Lipids Concentrations
- Figures 38 through 48: Plots of Metal Concentrations

References

- CDM Smith. 2010. Final Quality Assurance Project Plan (QAPP), Addendum No. 5 Fish Tissue Analysis
- Helsel, D.R. 2005. Nondetects and Data Analysis: Statistics for Censored Environmental Data. Wiley-Interscience.
- O'Brien, P.C. and T.R. Fleming. 1987. A Paired Prentice-Wilcoxon Test for Censored Paired Data. Biometrics 43: 169-180.

Table 1
Summary of 2012 Lower Passaic River Background Tissue Sampling Comparison

Parameter	Number of Split Sample Pairs	Number of Split Sample Paris with Detected Concentrations	Comparison Criteria					Overall Split Sample Comparison (Same or Different) ⁽⁶⁾
			Average Ratio of CPG to EPA (for detected pairs) ⁽¹⁾	Percent Difference (for detected pairs) ⁽²⁾	Statistical Tests			
					<i>p</i> -value		Statistical Difference (Yes or No) ⁽⁵⁾	
					Wilcoxon Signed Rank test ⁽³⁾	Paired Prentice Wilcoxon test ⁽⁴⁾		
Dioxins/Furans								
1,2,3,4,6,7,8-HpCDD	11	11	0.95±0.18	9% Outside Criteria	0.929	0.435	No	Same
1,2,3,4,6,7,8-HpCDF	11	11	1.09±0.58	18% Outside Criteria	0.534	0.893	No	Same
2,3,7,8-TCDD	11	11	0.94±0.09	Within Range	0.168	0.106	No	Same
2,3,7,8-TCDF	11	8	1.14±0.39	13% Outside Criteria	0.484	1.000	No	Same
OCDD	11	10	1.19±0.3	10% Outside Criteria	0.126	0.095	No	Same
OCDF	11	5	0.96±0.18	Within Range	0.590	0.114	No	Same
Total TCDD	11	10	1.04±0.27	10% Outside Criteria	0.683	0.660	No	Same
Pesticides								
4,4'-DDD	11	11	0.99±0.13	Within Range	0.859	0.448	No	Same
4,4'-DDE	11	11	0.97±0.21	9% Outside Criteria	0.859	0.926	No	Same
4,4'-DDT	11	11	2.97±6.32	9% Outside Criteria	0.230	0.132	No	Same
Dieldrin	11	10	1.02±0.13	Within Range	0.221	0.209	No	Same
alpha-Chlordane	11	11	0.93±0.08	Within Range	0.056	0.162	No	Same
2,4'-DDD	11	11	1.45±0.32	27% Outside Criteria	0.004	0.005	Yes	Different
2,4'-DDE	11	11	1.37±0.29	18% Outside Criteria	0.004	0.003	Yes	Different
2,4'-DDT	11	8	1.38±0.61	25% Outside Criteria	0.141	0.079	No	Different
Polychlorinated Biphenyls (PCBs)								
3,3',4,4'-Tetrachlorobiphenyl (PCB 77)	11	11	0.91±0.08	Within Range	0.018	0.007	Yes	Same
3,4,4',5-Tetrachlorobiphenyl (PCB 81)	11	9	1.04±0.17	Within Range	0.407	0.379	No	Same
2,3,3',4,4'-Pentachlorobiphenyl (PCB 105)	11	11	1.01±0.12	Within Range	0.398	0.639	No	Same
2,3,4,4',5-Pentachlorobiphenyl (PCB 114)	11	11	0.97±0.08	Within Range	0.230	0.317	No	Same
2,3',4,4',5-Pentachlorobiphenyl (PCB 118)	11	11	1.02±0.11	Within Range	0.351	0.714	No	Same
2',3,4,4',5-Pentachlorobiphenyl (PCB 123)	11	11	1±0.14	Within Range	1.000	0.634	No	Same
3,3',4,4',5-Pentachlorobiphenyl (PCB 126)	11	11	1±0.18	Within Range	0.824	0.886	No	Same
2,3,3',4,4',5-Hexachlorobiphenyl + 2,3,3',4,4',5'-Hexachlorobiphenyl (PCB 156 + 157)	11	11	1.07±0.1	Within Range	0.068	0.147	No	Same
2,3',4,4',5,5'-Hexachlorobiphenyl (PCB 167)	11	11	1.02±0.09	Within Range	0.197	0.170	No	Same
3,3',4,4',5,5'-Hexachlorobiphenyl (PCB 169)	11	0	NA	NA	NA	NA	NA	NA
2,3,3',4,4',5,5'-Heptachlorobiphenyl (PCB 189)	11	11	0.97±0.09	Within Range	0.120	0.093	No	Same
Total PCBs	11	11	0.94±0.08	Within Range	0.083	0.090	No	Same
Polycyclic Aromatic Hydrocarbons (PAHs)								
Anthracene	11	11	1.89±0.7	45% Outside Criteria	0.004	0.005	Yes	Different
Benzo[a]anthracene	11	10	0.97±0.29	10% Outside Criteria	0.683	0.348	No	Same
Benzo[a]pyrene	11	3	1.06±0.17	Within Range	0.789	0.380	No	Same
Chrysene	11	10	0.70±0.39	50% Outside Criteria	0.067	0.118	No	Same
Fluoranthene	11	11	1.01±0.09	Within Range	0.929	0.863	No	Same
Indeno[1,2,3-cd]pyrene	11	2	0.79±0.08	Within Range	0.371	0.121	No	Same
Naphthalene	11	3	1.33±0.22	Within Range	0.181	0.019	Yes	Different
Phenanthrene	11	10	1.08±0.14	Within Range	0.126	0.209	No	Same
Pyrene	11	11	1.08±0.29	9% Outside Criteria	0.625	0.890	No	Same
Total Extractable Lipids								
Total Extractable Lipids	11	11	0.8±0.2	9% Outside Criteria	0.005	0.022	Yes	Same
Metals								
Arsenic	11	5	0.15±0.08	100% Outside Criteria	0.059	0.012	Yes	Different
Barium	11	11	0.93±0.3	18% Outside Criteria	0.056	0.107	No	Same
Cadmium	11	4	4.23±3.46	100% Outside Criteria	0.100	0.004	Yes	Different
Chromium	11	5	1.01±0.21	Within Range	1.000	0.354	No	Same
Cobalt	11	2	0.86±0.09	Within Range	0.371	0.157	No	Same
Copper	11	9	0.8±0.13	11% Outside Criteria	0.009	0.014	Yes	Same
Iron	11	11	1±0.07	Within Range	0.563	0.856	No	Same
Lead	11	5	0.68±0.11	40% Outside Criteria	0.059	0.057	No	Different
Nickel	11	8	0.82±0.13	Within Range	0.021	0.079	No	Same
Zinc	11	11	0.95±0.03	Within Range	0.008	0.012	Yes	Same
Mercury	11	11	1.4±0.71	18% Outside Criteria	0.004	0.003	Yes	Different

Results outside acceptance criteria are bolded.

NA = not applicable

EPA = United States Environmental Protection Agency

CPG = Cooperating Parties Group

Notes:

- (1) Average ratio (criteria: 0.70-1.30) with standard deviation
(2) Percent difference criteria: no more than 16% of split samples outside of 40 to -67 %D.
(3) Wilcoxon Signed Rank test was employed at significance level (*p*- value) of 0.05.
(4) Paired Prentice Wilcoxon test was employed at significance level (*p*-value) of 0.05.
(5) Statistical difference was based on both tests when they drew the same conclusion.
Otherwise, it was based on Paired Prentice Wilcoxon test, which had more power to discern the difference.
(6) If there are at least two of the three criteria (average ratio, percent different and statistical difference) met, the overall split sample comparison would be labeled "same". Otherwise, it would be "different".

Abbreviations:

1,2,3,4,6,7,8-HpCDD = 1,2,3,4,6,7,8- heptachlorodibenzo-p-dioxin
1,2,3,4,6,7,8-HpCDF = 1,2,3,4,6,7,8- heptachlorodibenzofuran
2,3,7,8-TCDD = 2,3,7,8-tetrachlorodibenzo-p-dioxin
2,3,7,8-TCDF = 2,3,7,8-tetrachlorodibenzofuran
OCDD = octachlorodibenzo-p-dioxin
OCDF = octachlorodibenzofuran
Total TCDD = total tetrachlorodibenzo-p-dioxin

Total PCBs = total polychlorinated biphenyls
2,4'-DDD = 2,4'-dichlorodiphenyldichloroethane
2,4'-DDE = 2,4'-dichlorodiphenyldichloroethylene
2,4'-DDT = 2,4'-dichlorodiphenyltrichloroethane
4,4'-DDD = 4,4'-dichlorodiphenyldichloroethane
4,4'-DDE = 4,4'-dichlorodiphenyldichloroethylene
4,4'-DDT = 4,4'-dichlorodiphenyltrichloroethane

Figure 1a: Line Plot of 1,2,3,4,6,7,8-HpCDD Concentrations

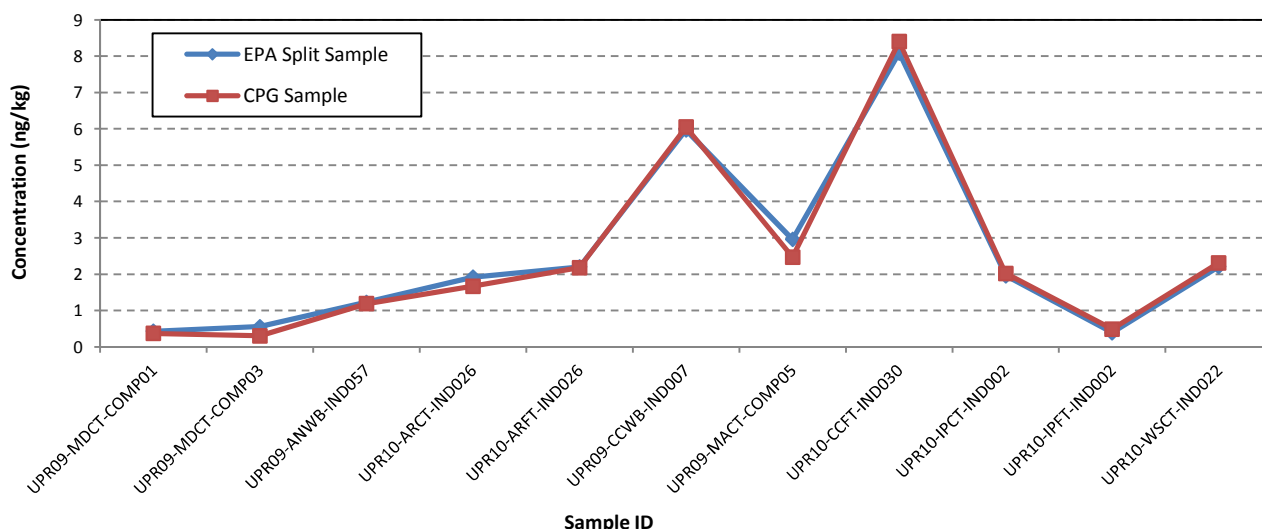


Figure 1b: Bivariate Plot of 1,2,3,4,6,7,8-HpCDD Concentrations

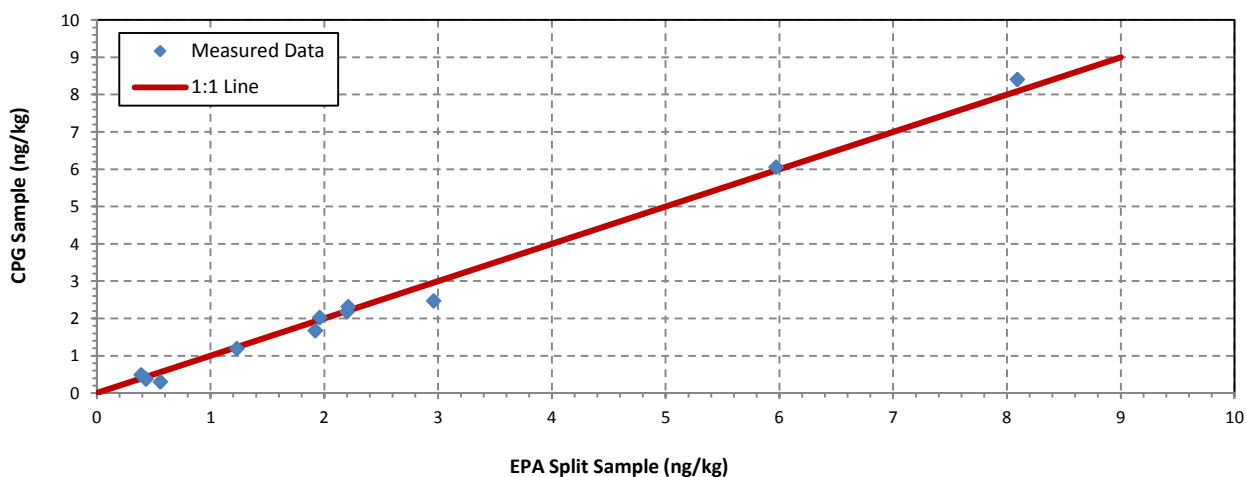
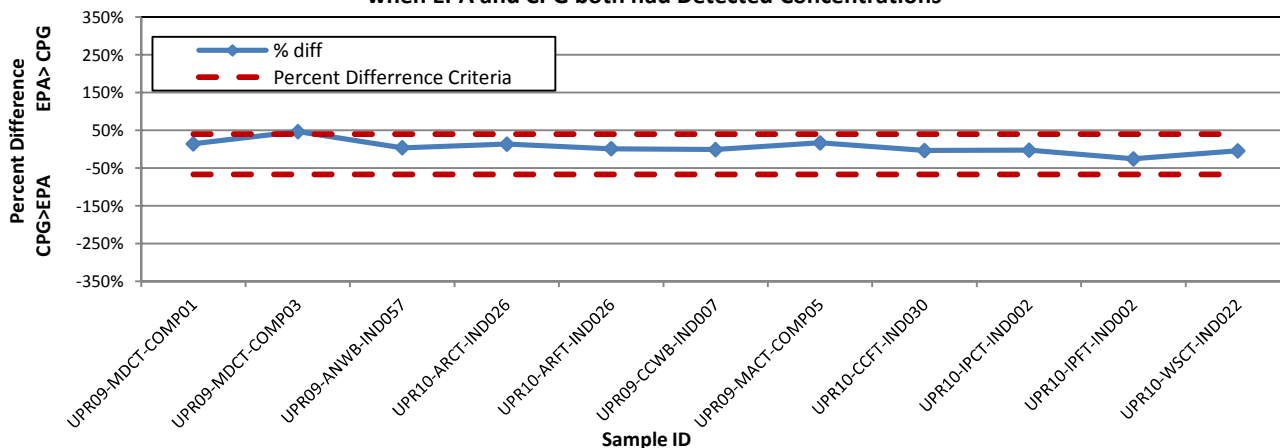


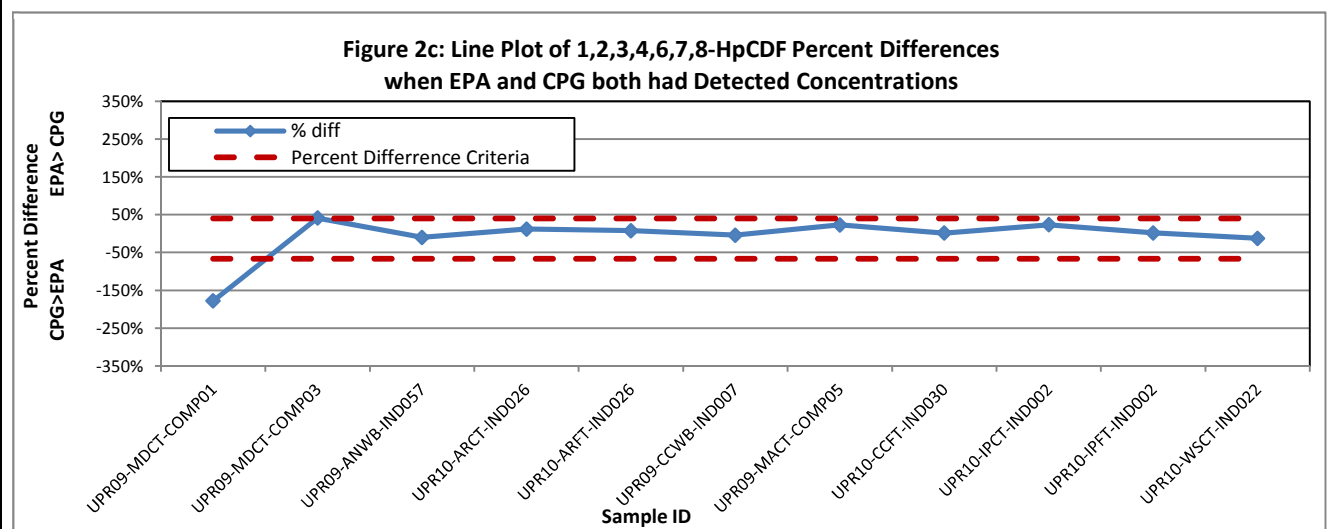
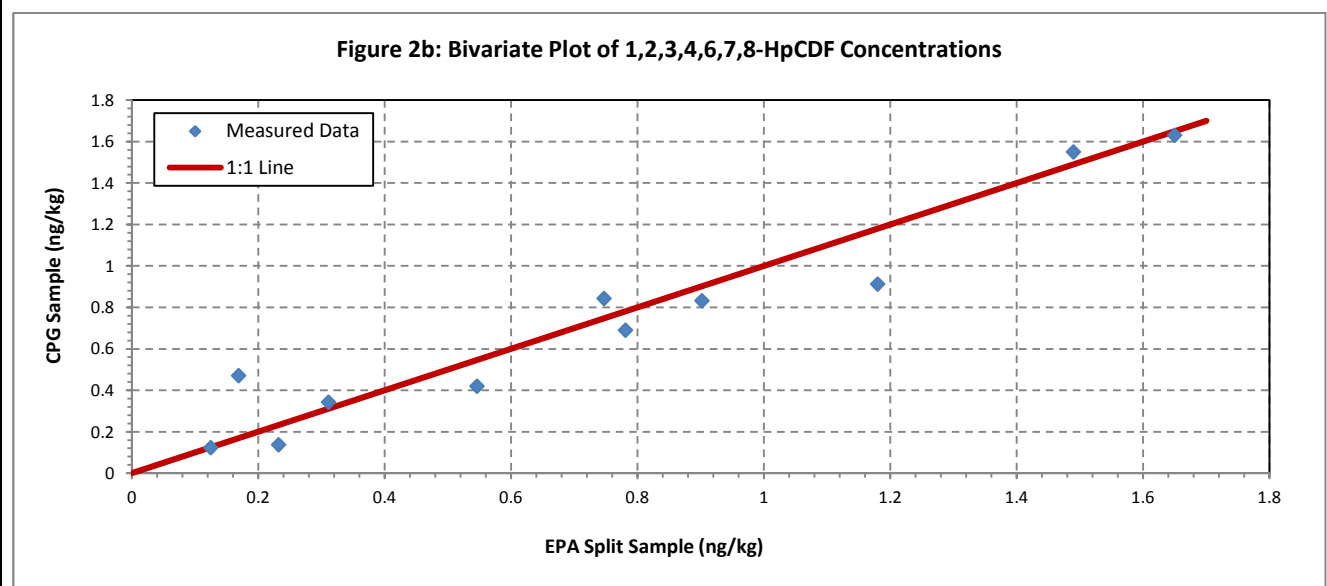
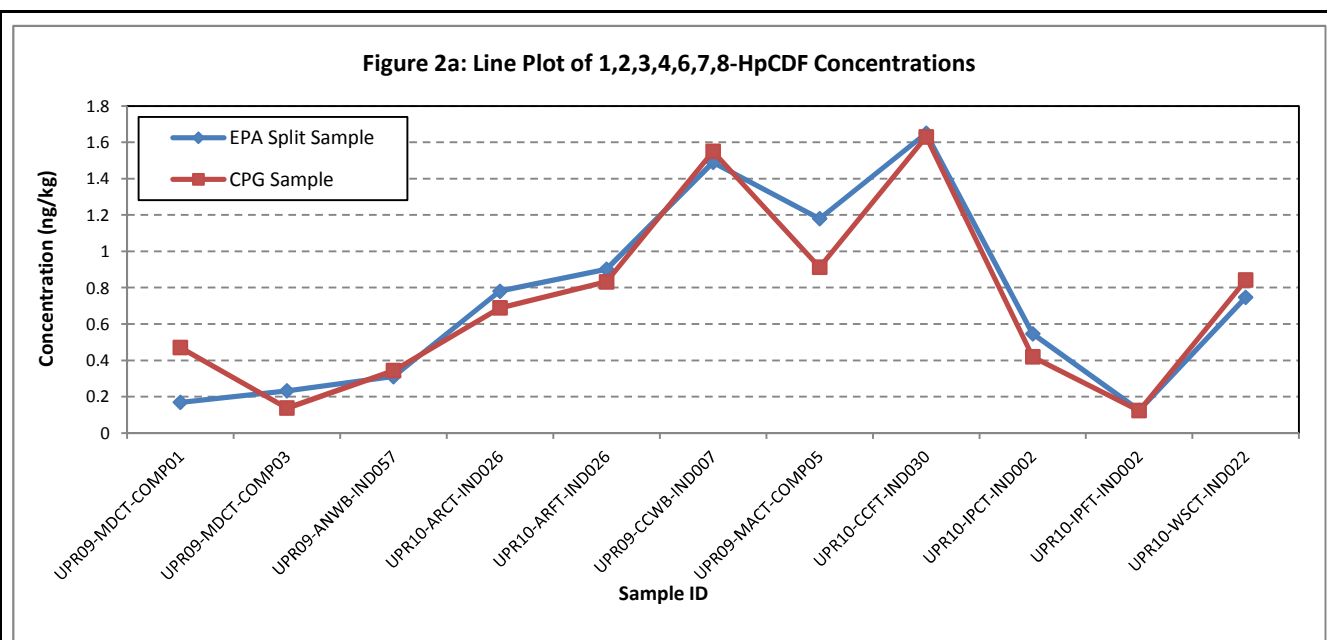
Figure 1c: Line Plot of 1,2,3,4,6,7,8-HpCDD Percent Differences when EPA and CPG both had Detected Concentrations



Statistical Plot of 1,2,3,4,6,7,8-HpCDD Concentrations

Figure 1

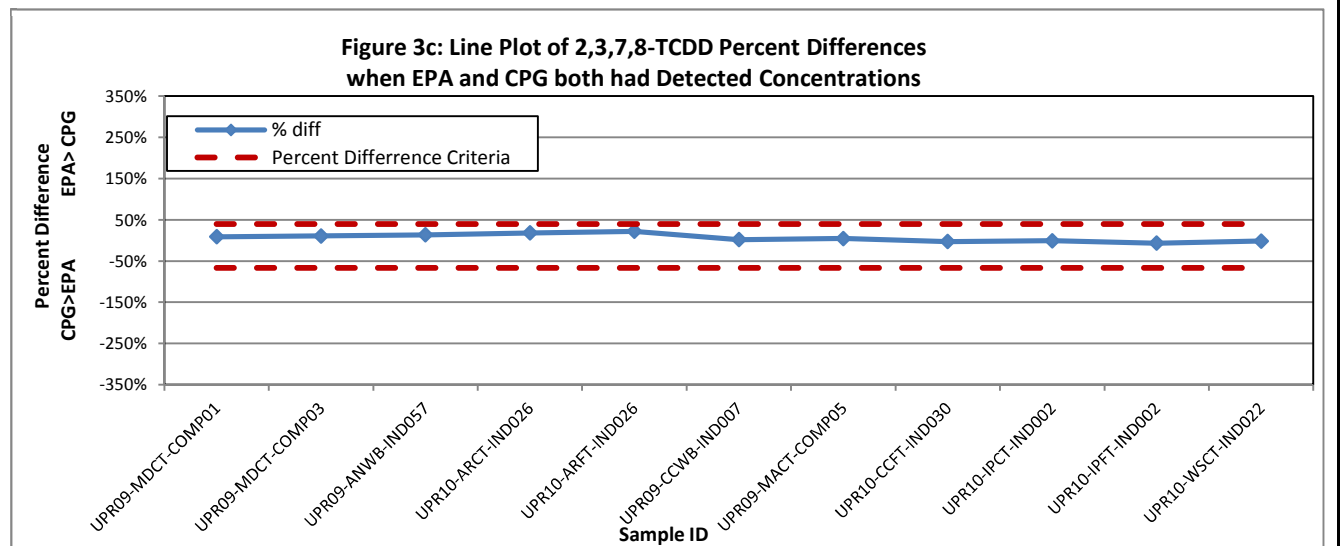
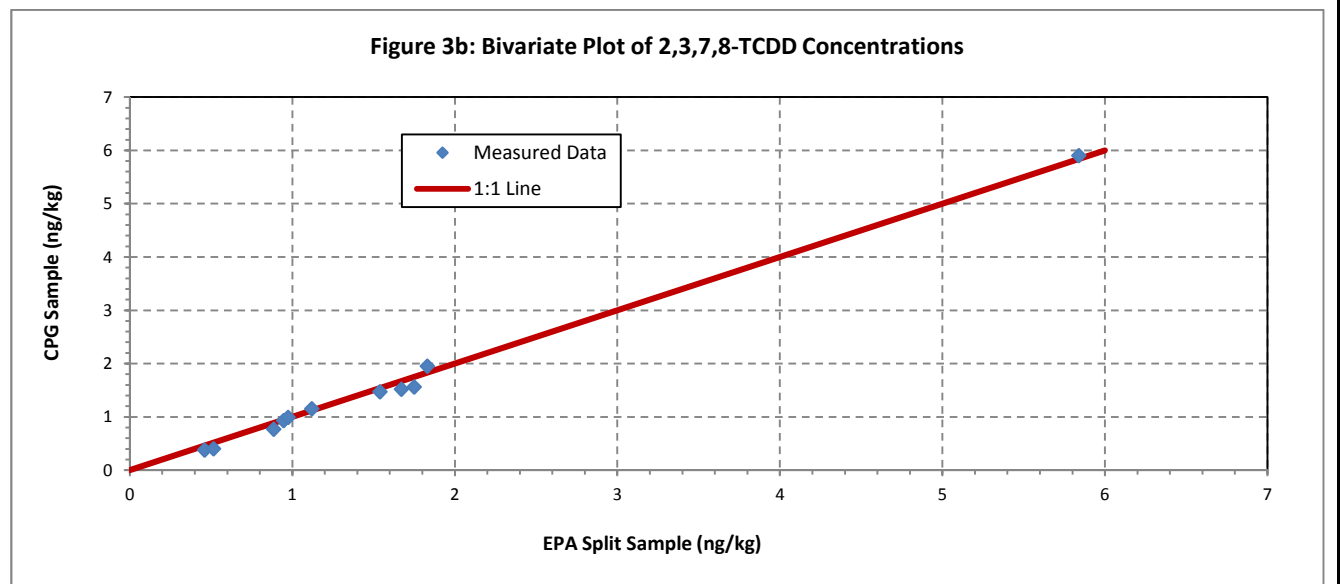
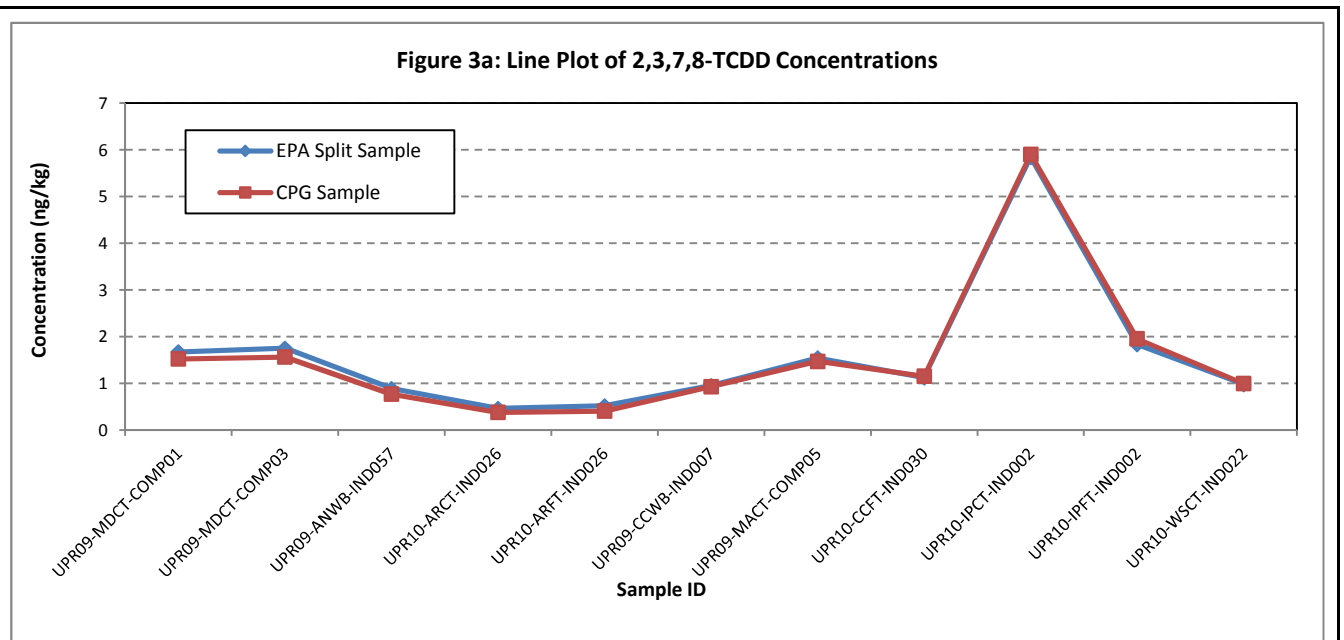
1,2,3,4,6,7,8-HpCDD = 1,2,3,4,6,7,8- heptachlorodibenzo-p-dioxin



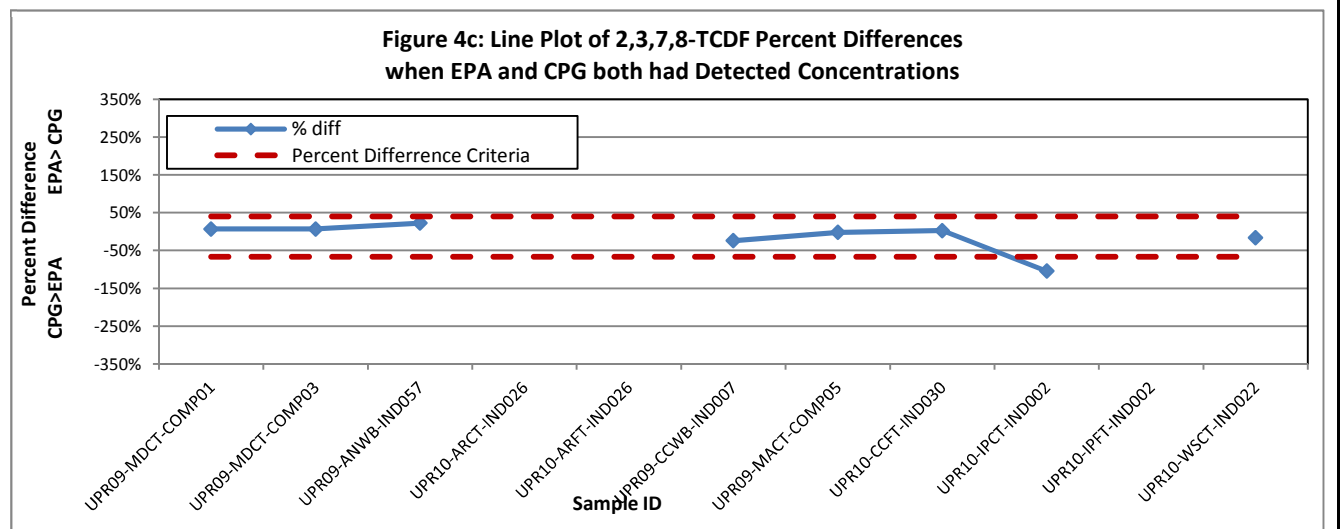
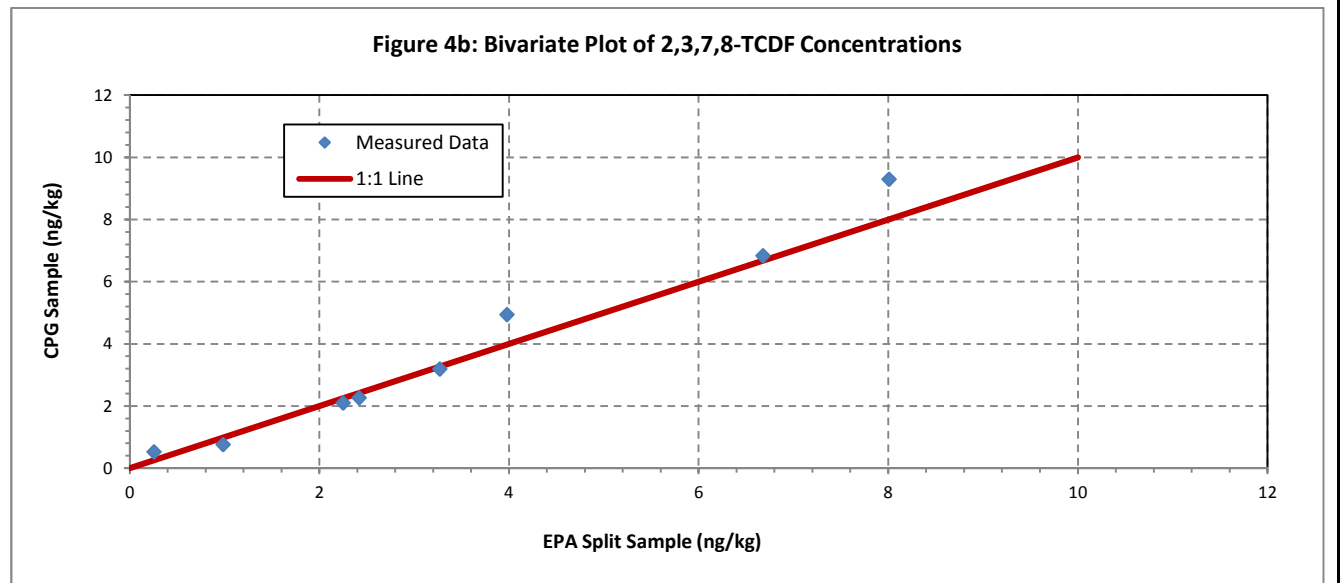
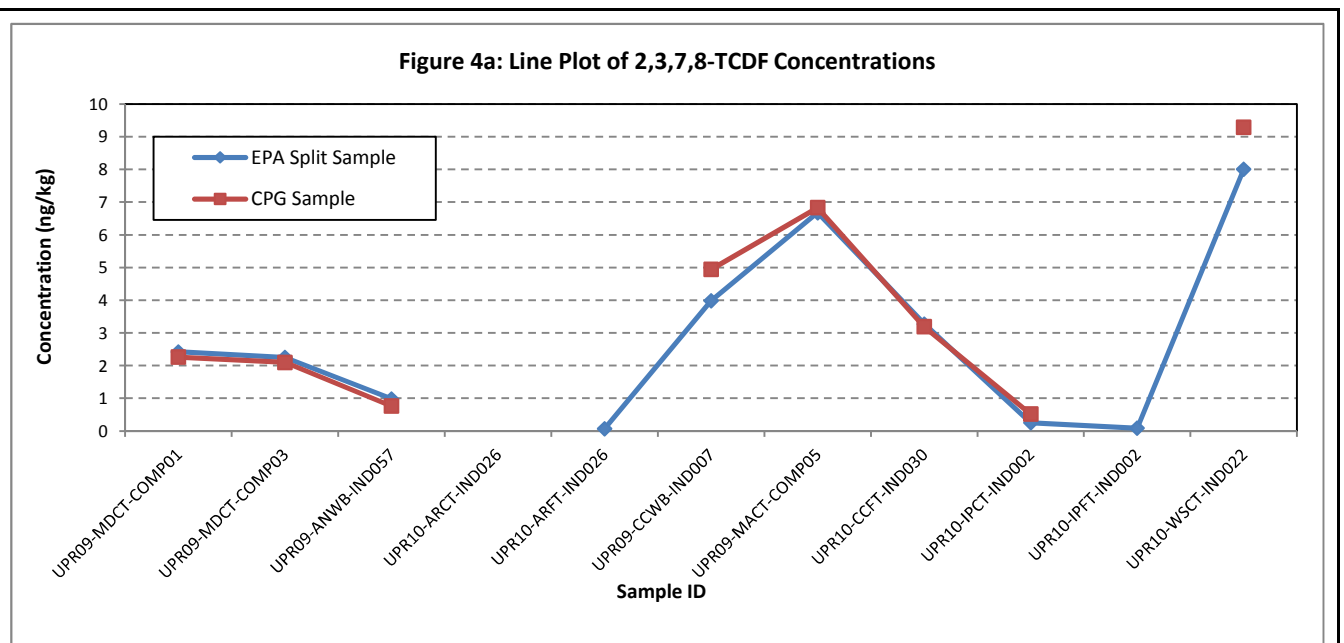
Statistical Plot of 1,2,3,4,6,7,8-HpCDF Concentrations

Figure 2

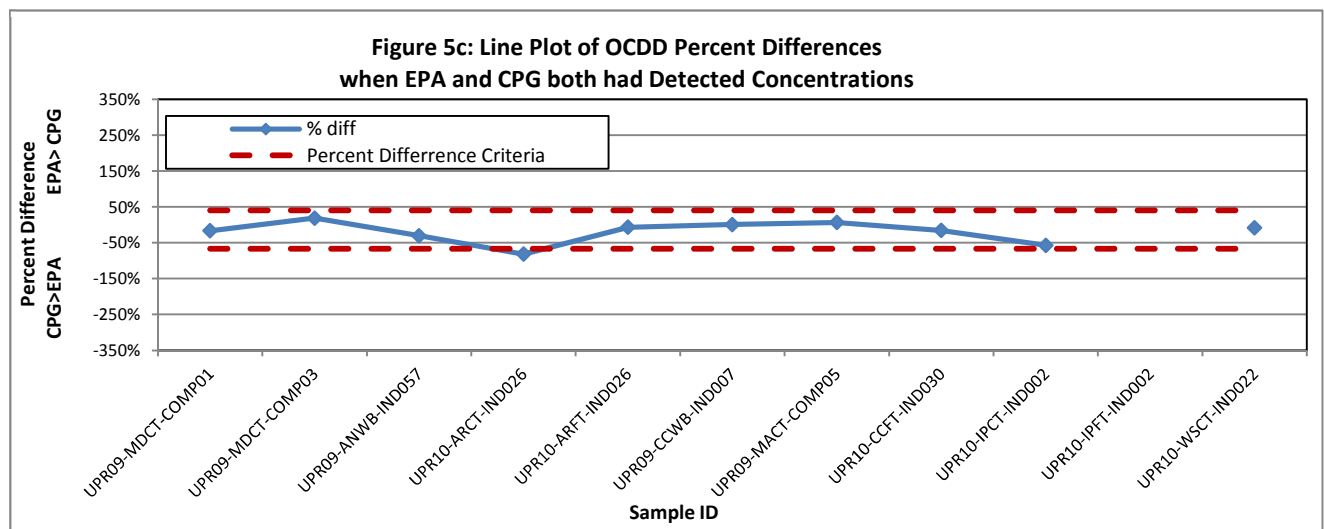
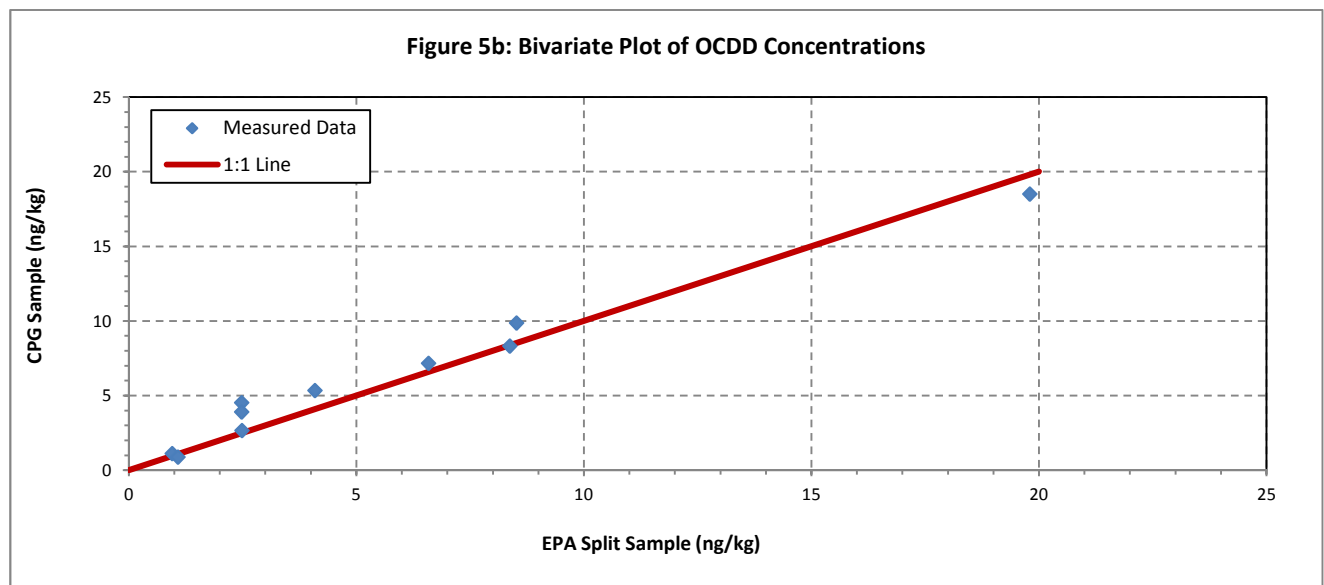
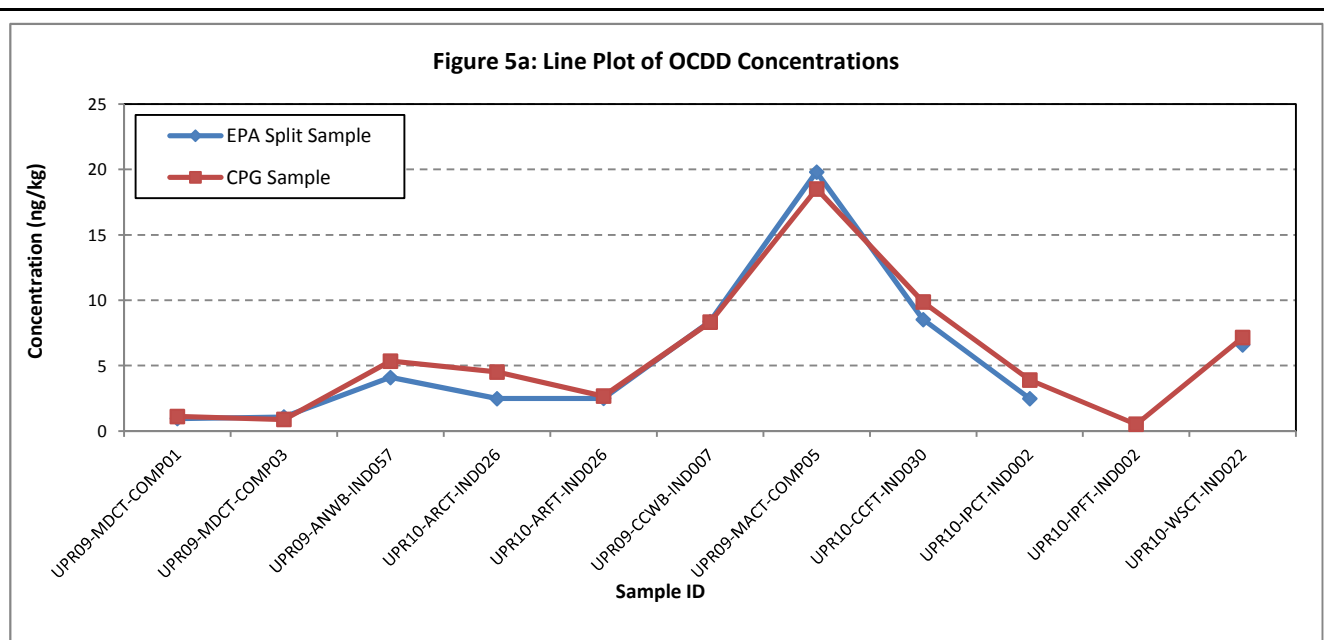
1,2,3,4,6,7,8-HpCDF = 1,2,3,4,6,7,8- heptachlorodibenzofuran



2,3,7,8-TCDD = 2,3,7,8-tetrachlorodibenzo-p-dioxin



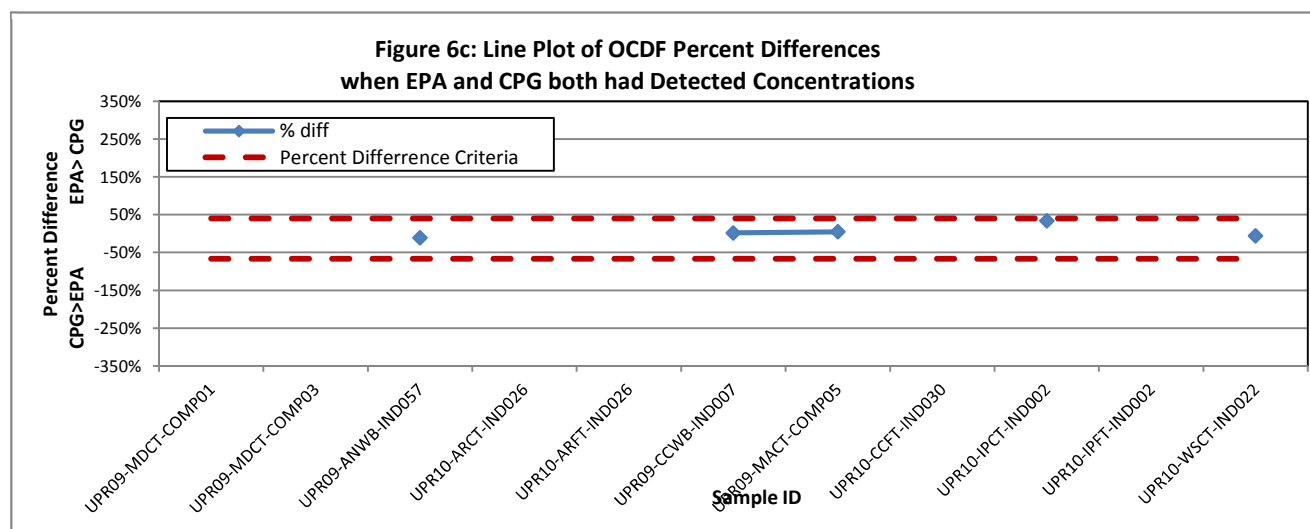
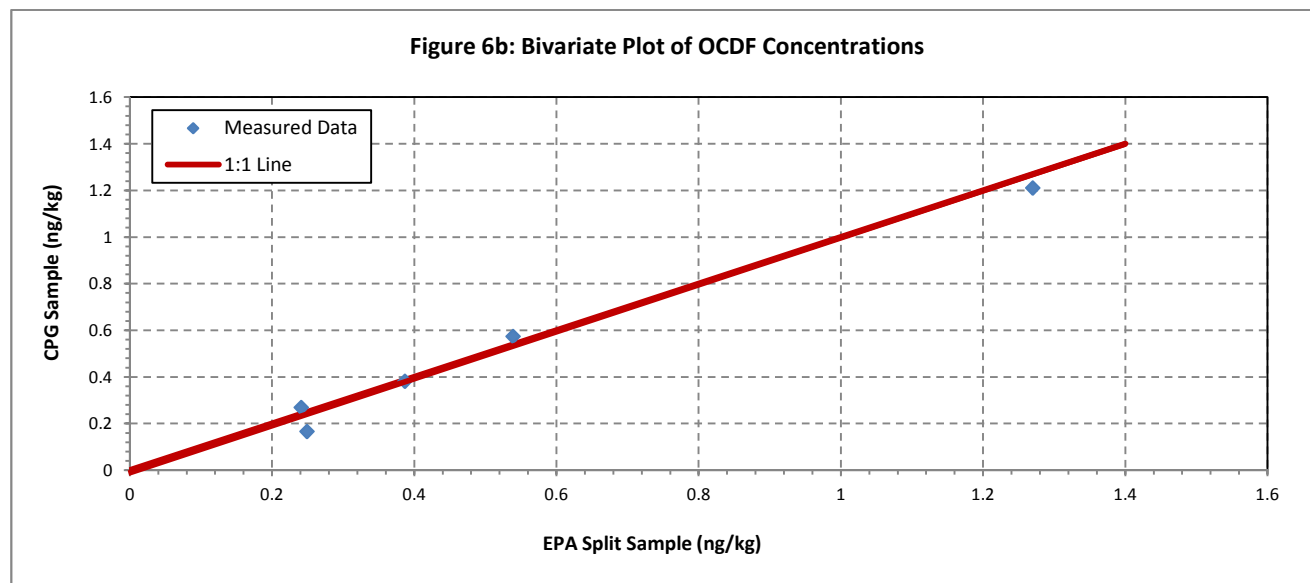
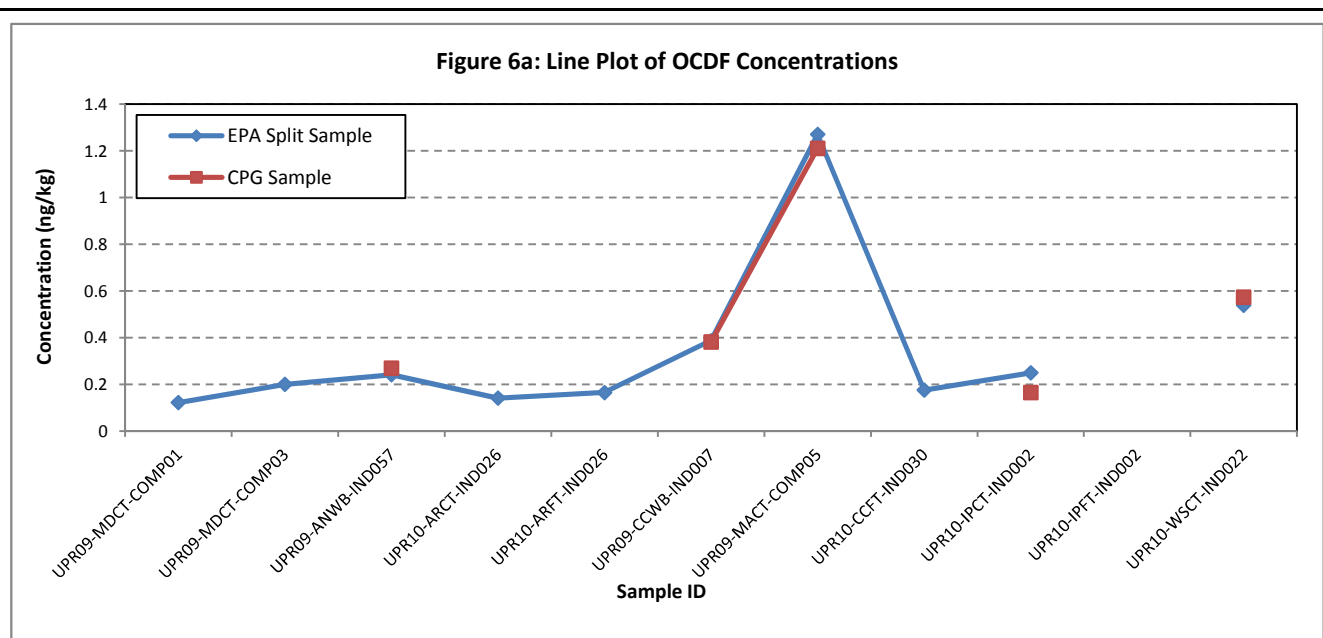
2,3,7,8-TCDF = 2,3,7,8-tetrachlorodibenzofuran



Statistical Plot of OCDD Concentrations

Figure 5

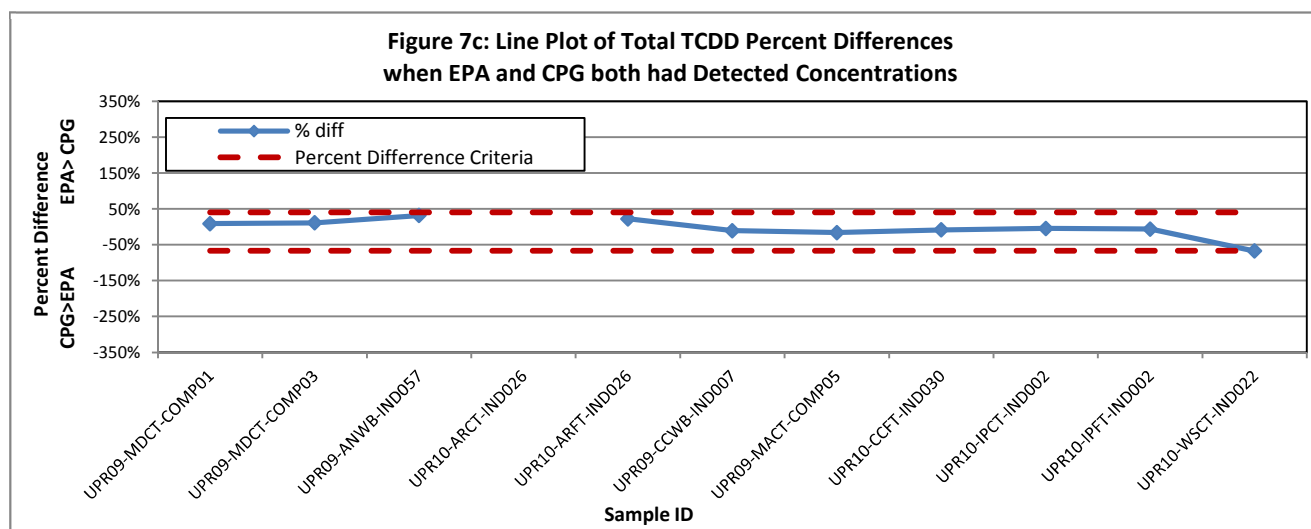
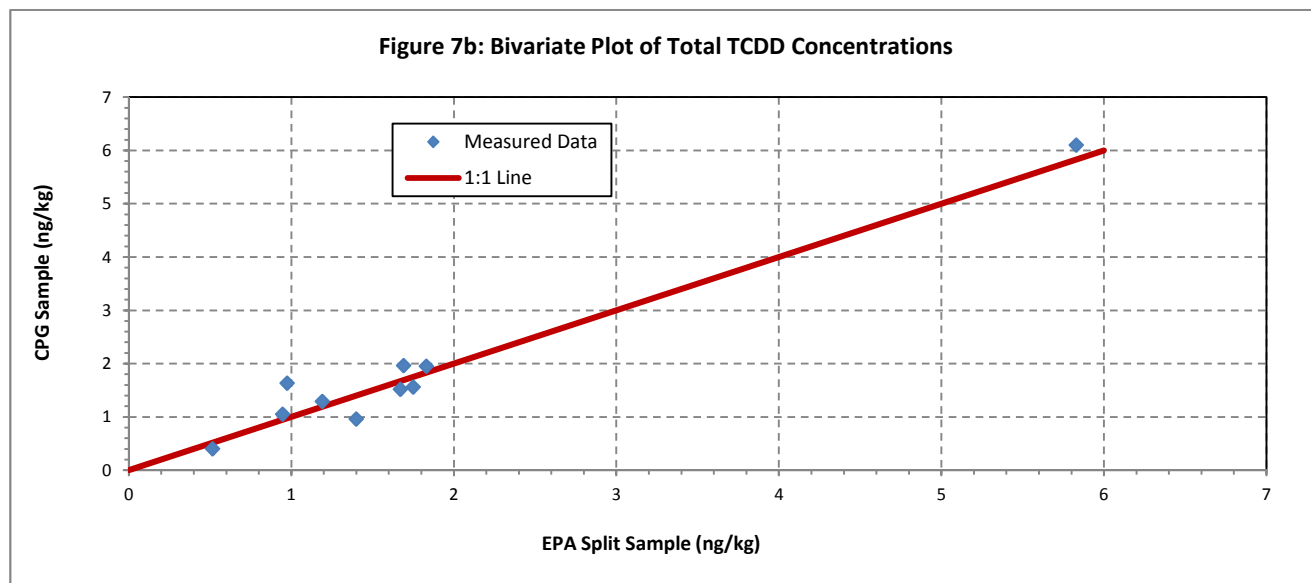
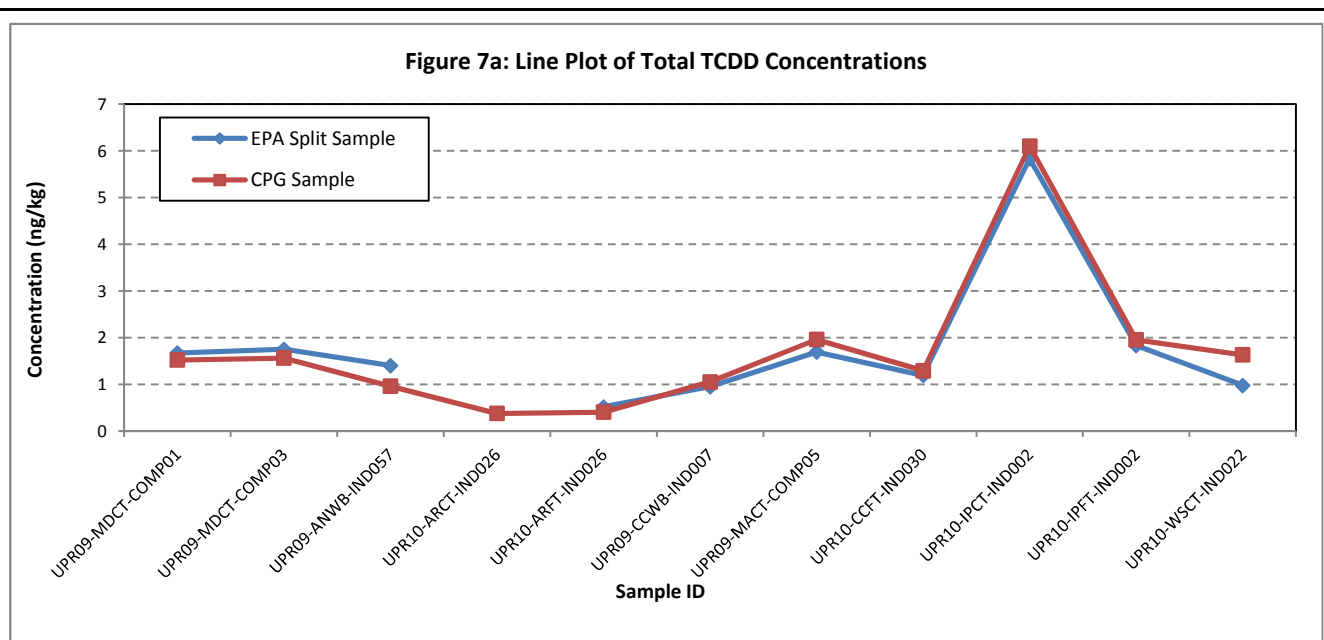
OCDD = octachlorodibenzo-p-dioxin

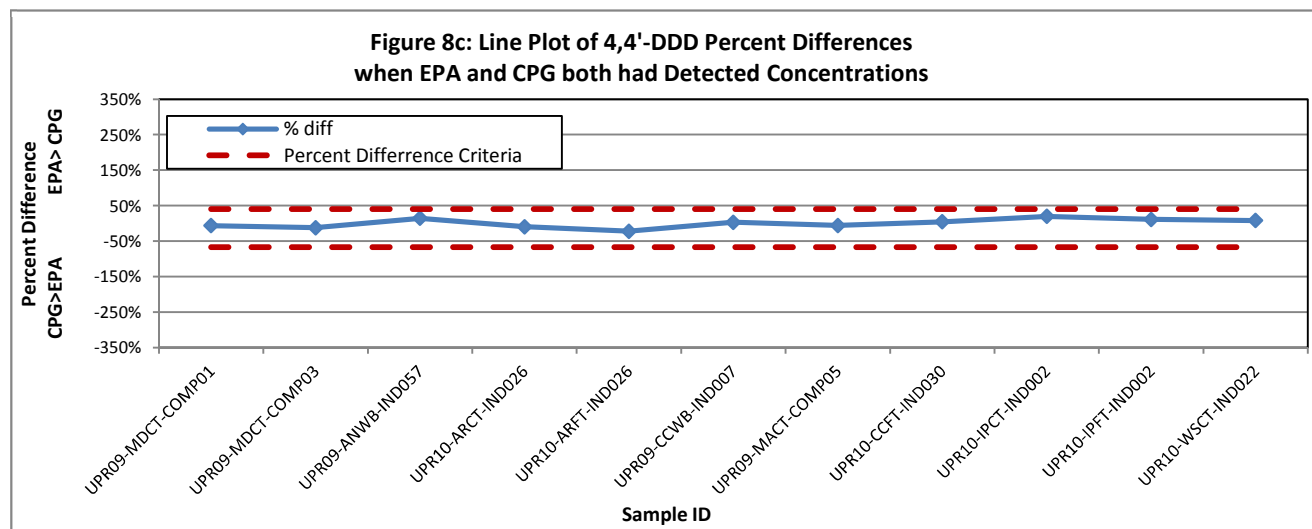
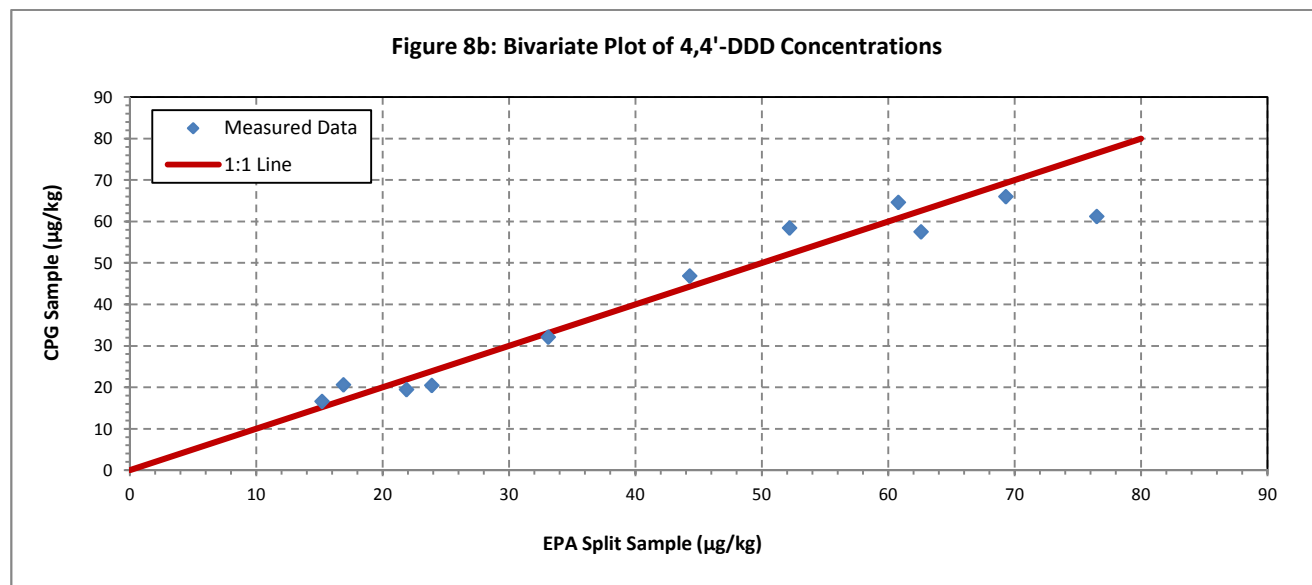
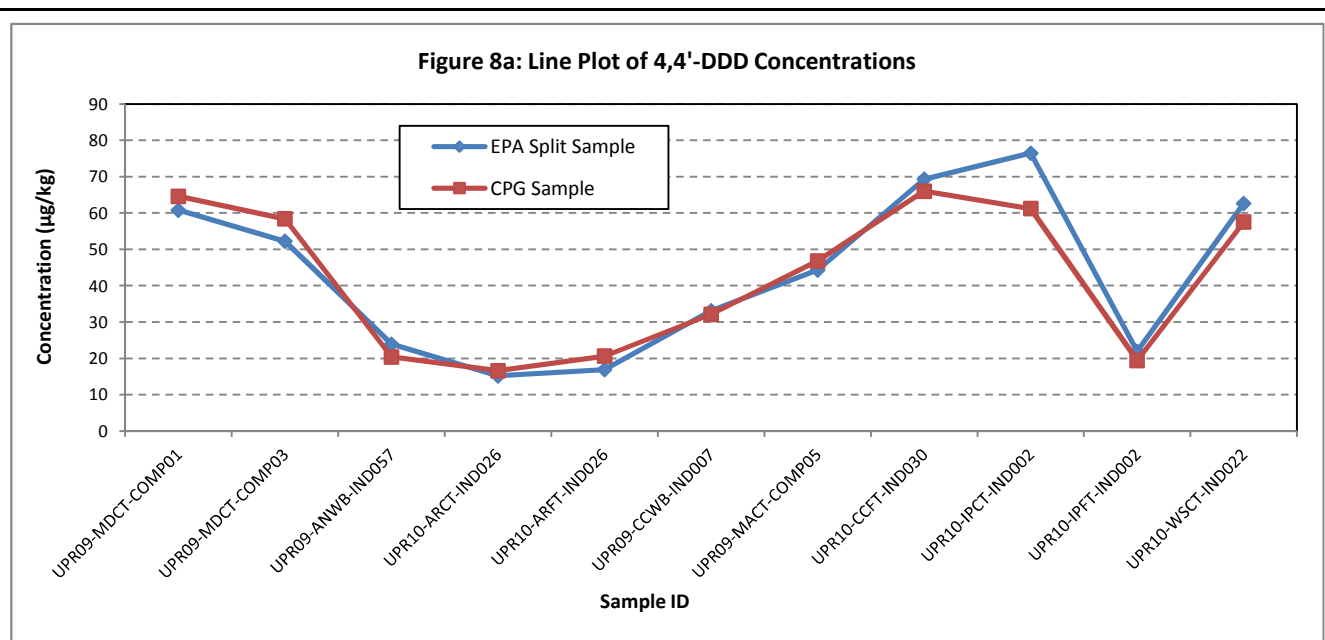


Statistical Plot of OCDF Concentrations

Figure 6

OCDF = octachlorodibenzofuran

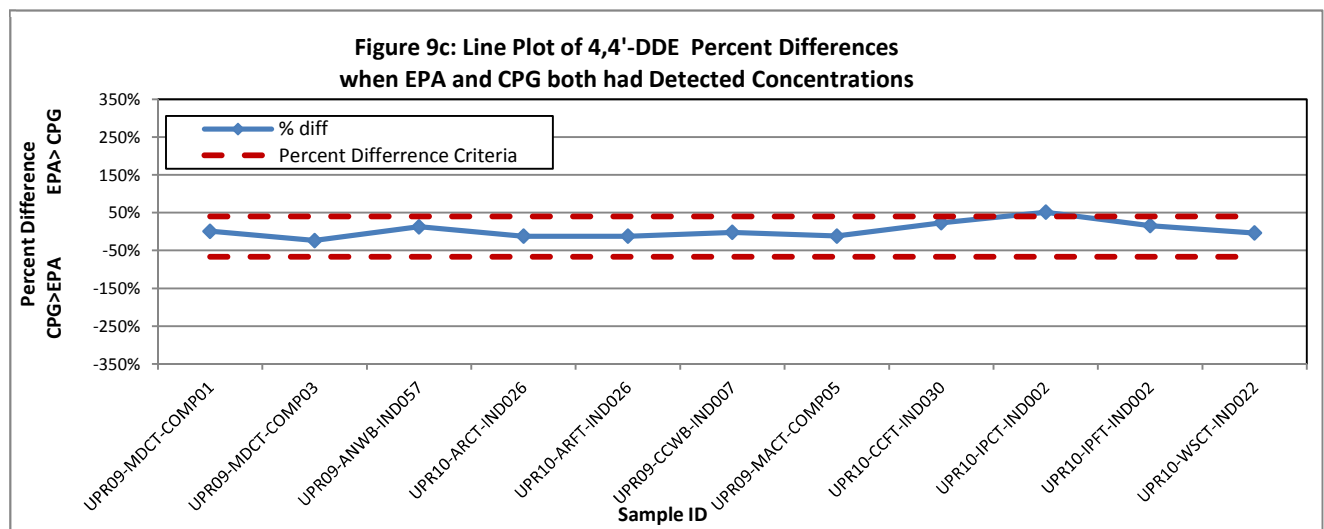
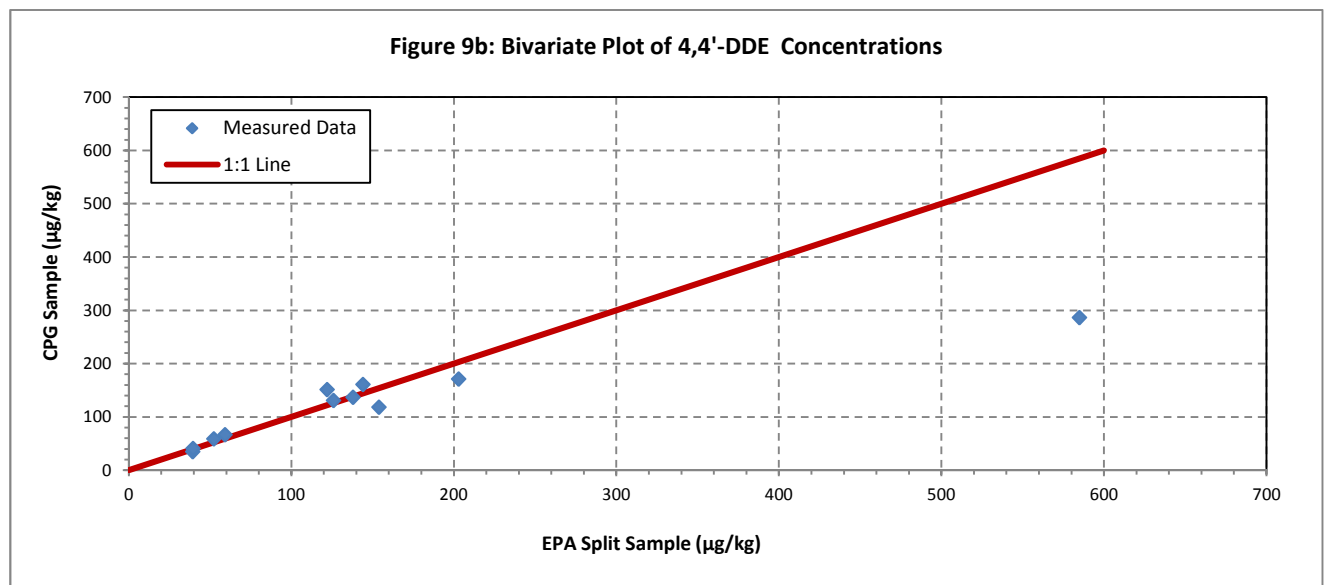
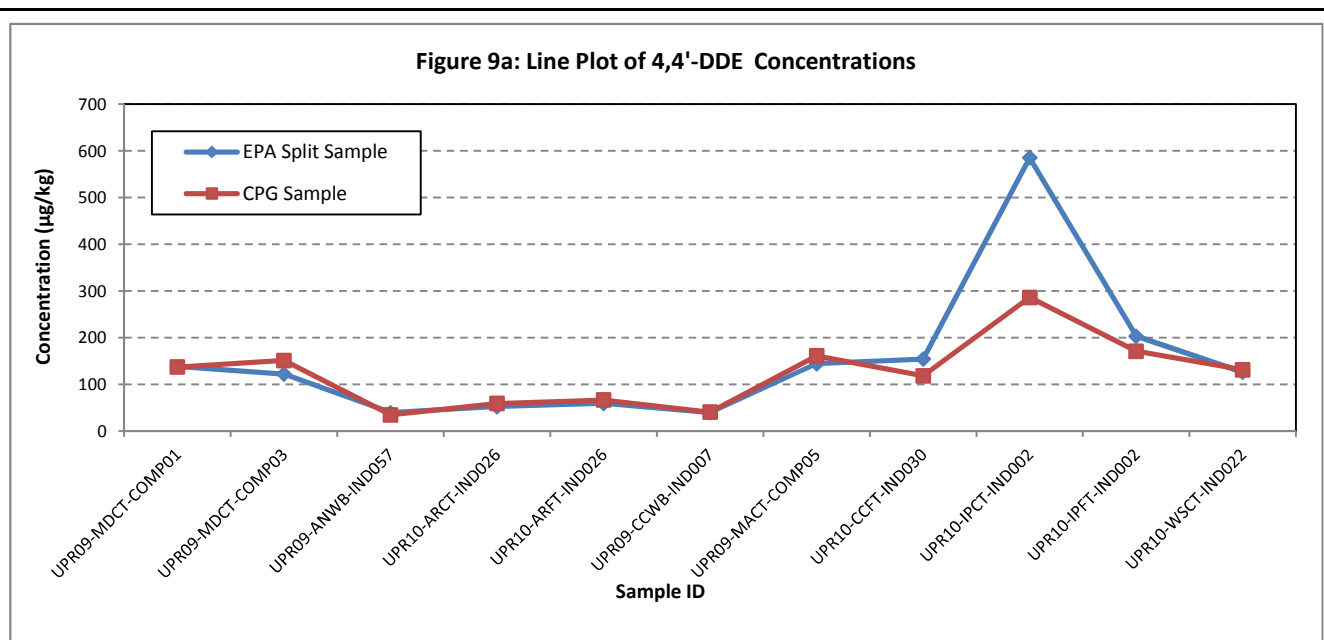




Statistical Plot of 4,4'-DDD Concentrations

Figure 8

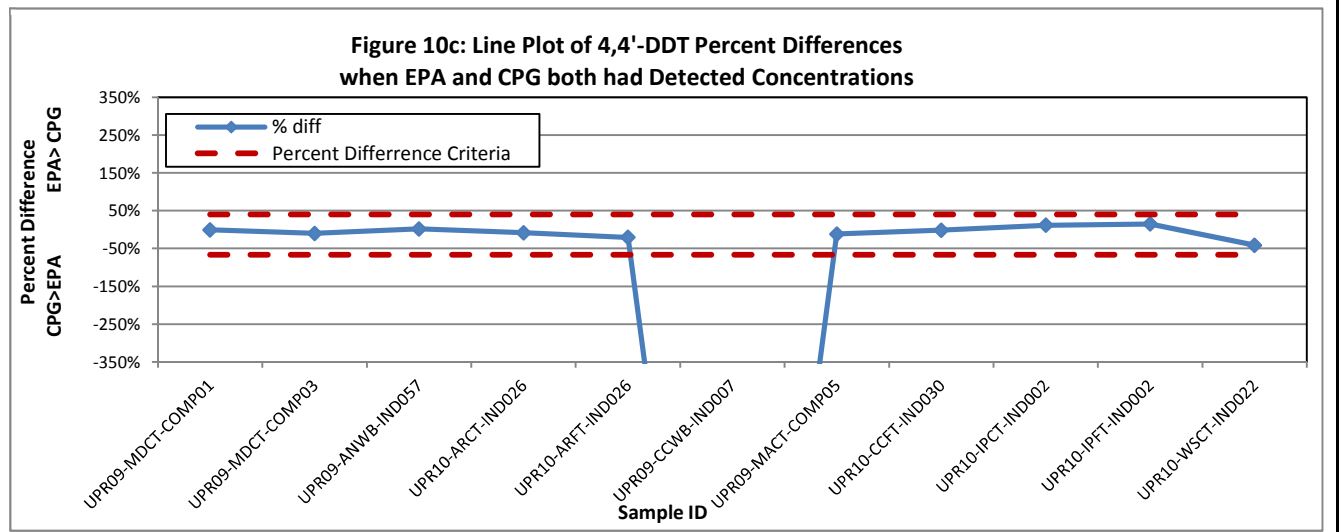
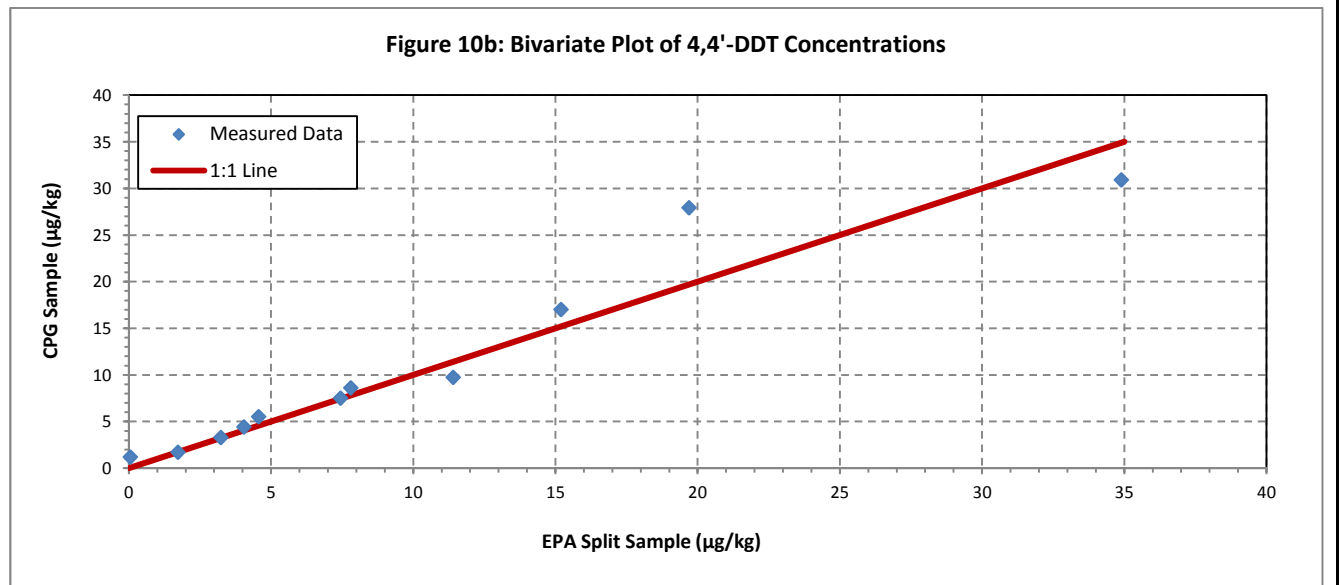
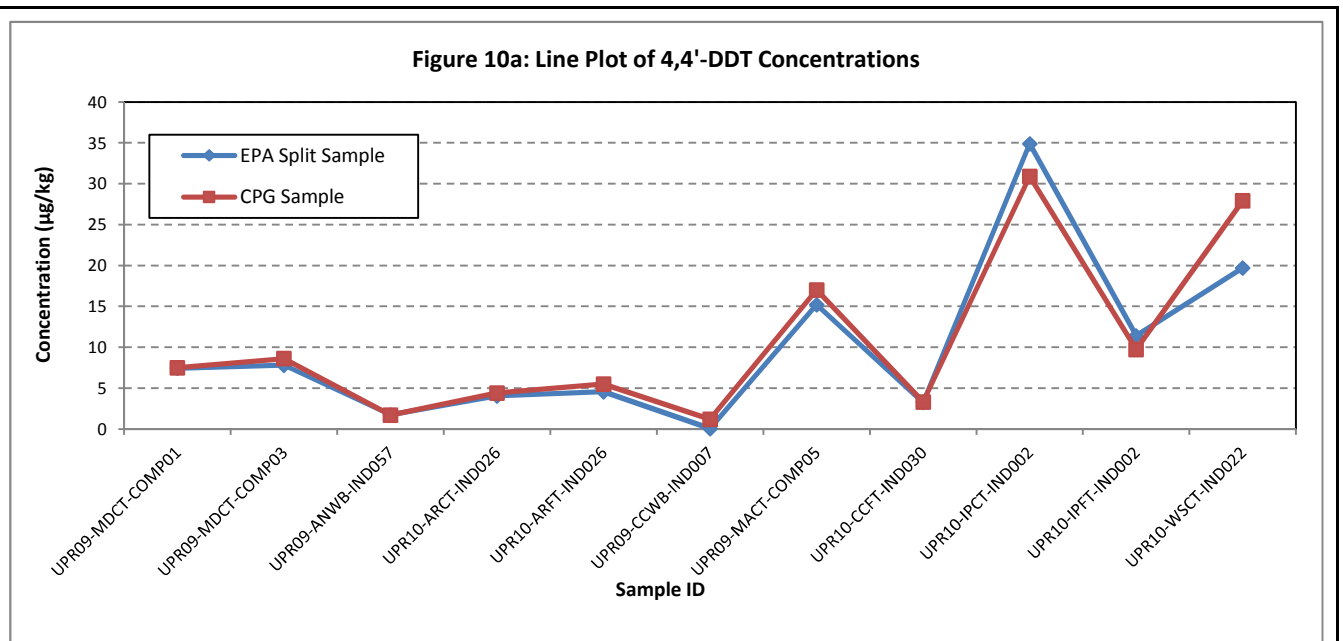
4,4'-DDD = 4,4'-dichlorodiphenyldichloroethane



Statistical Plot of 4,4'-DDE Concentrations

Figure 9

4,4'-DDE = 4,4'-dichlorodiphenyldichloroethylene



Statistical Plot of 4,4'-DDT Concentrations

Figure 10

4,4'-DDT = 4,4'-dichlorodiphenyltrichloroethane

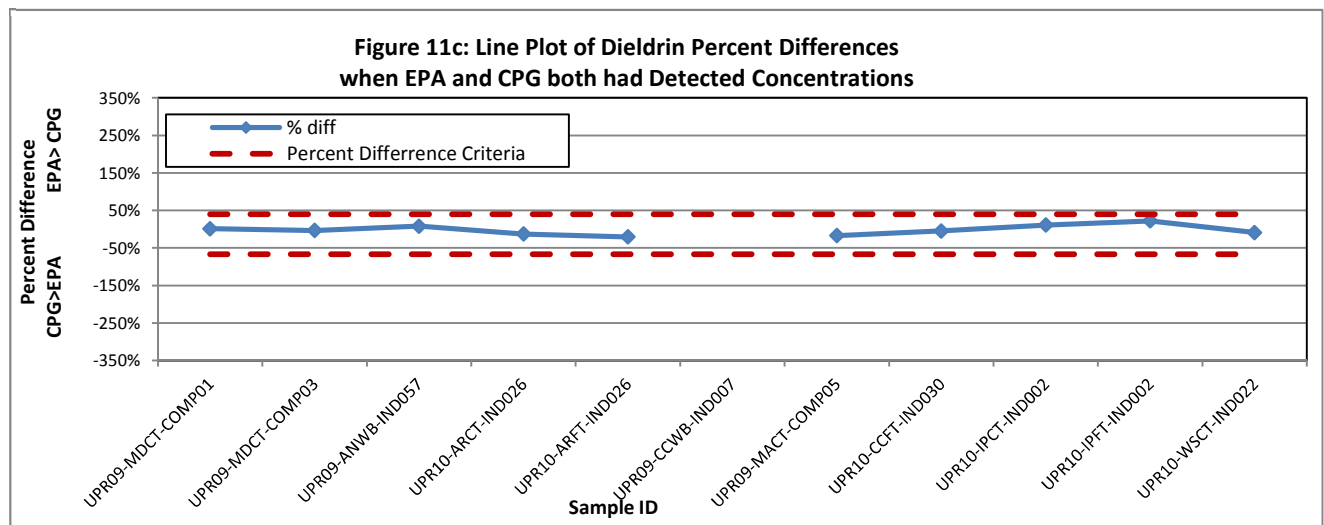
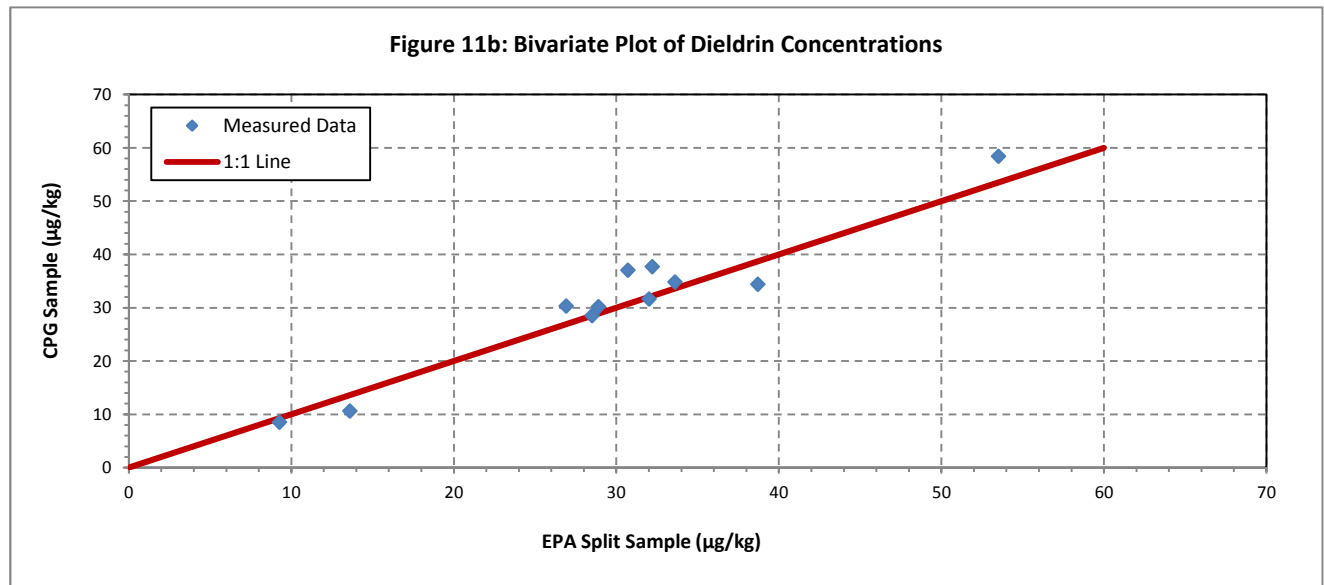
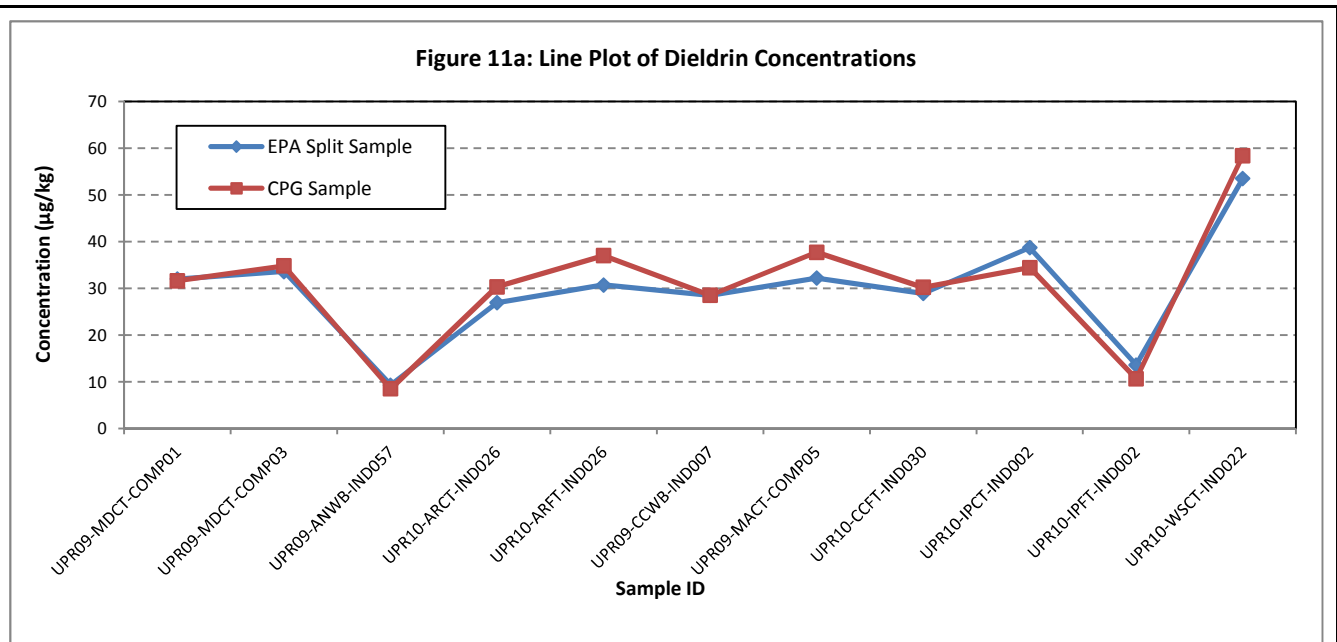


Figure 12a: Line Plot of alpha-Chlordane Concentrations

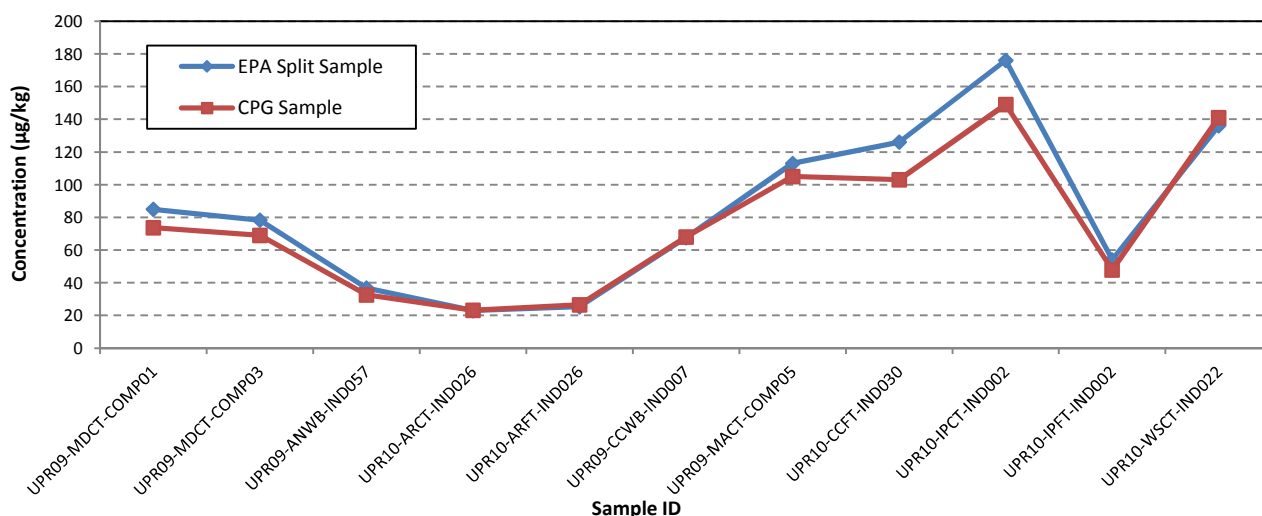


Figure 12b: Bivariate Plot of alpha-Chlordane Concentrations

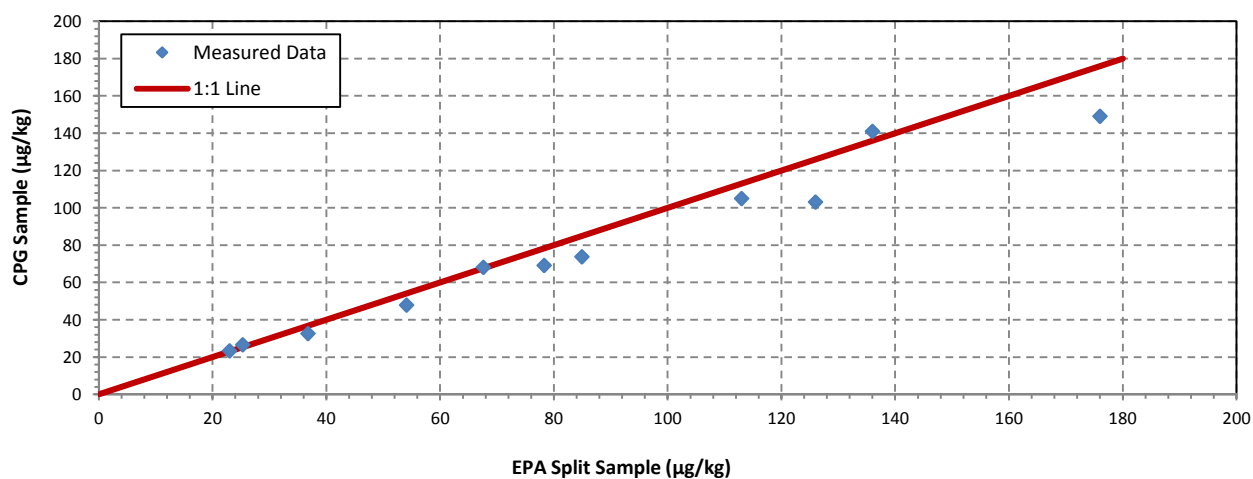
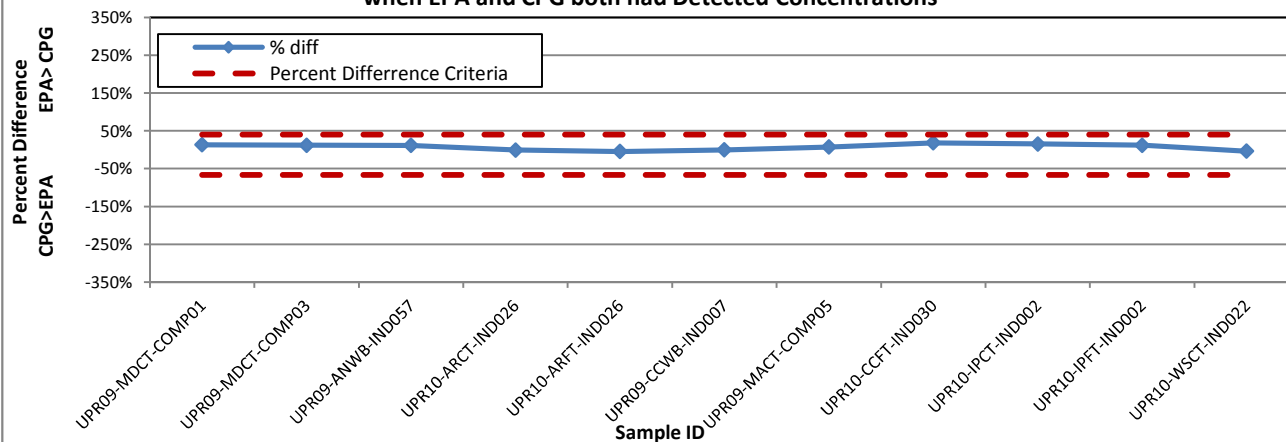
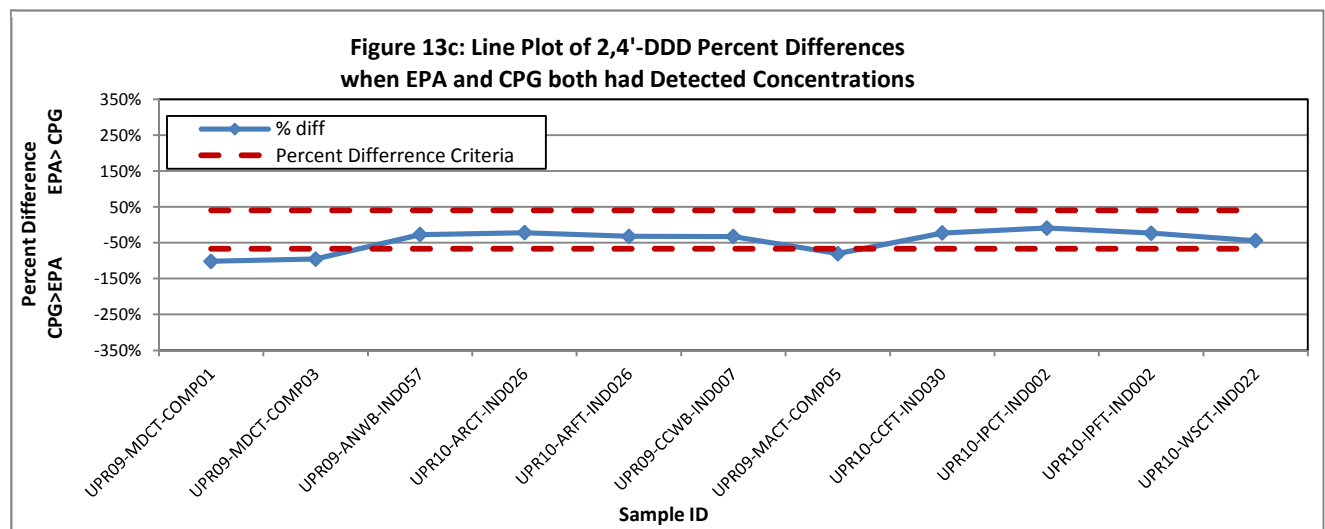
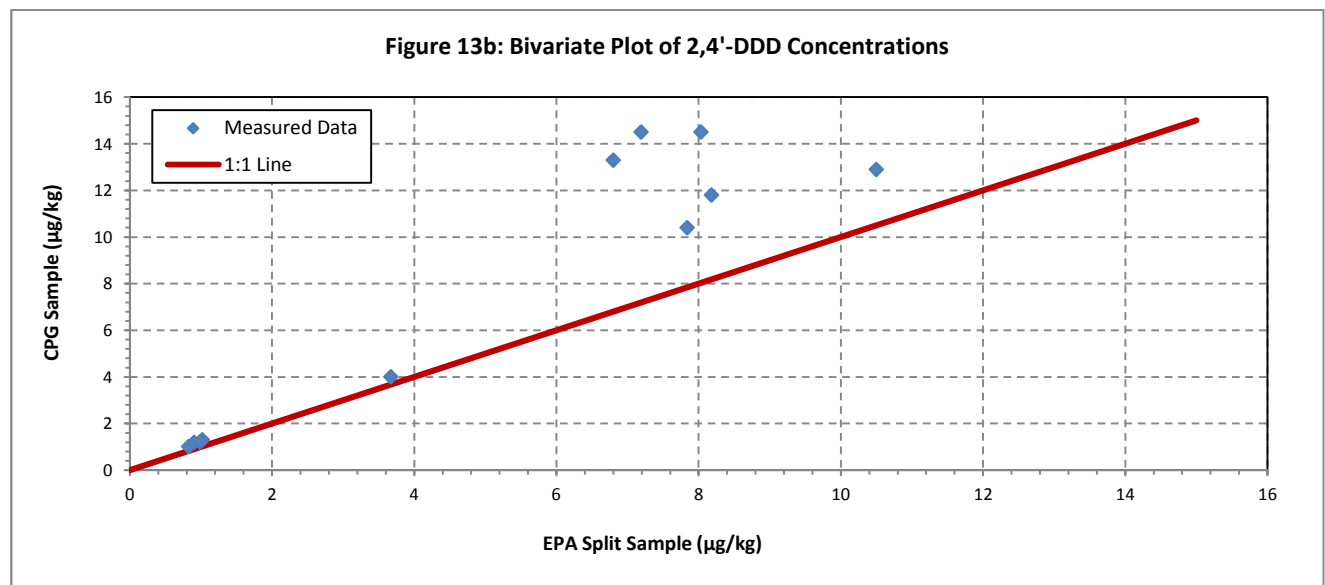
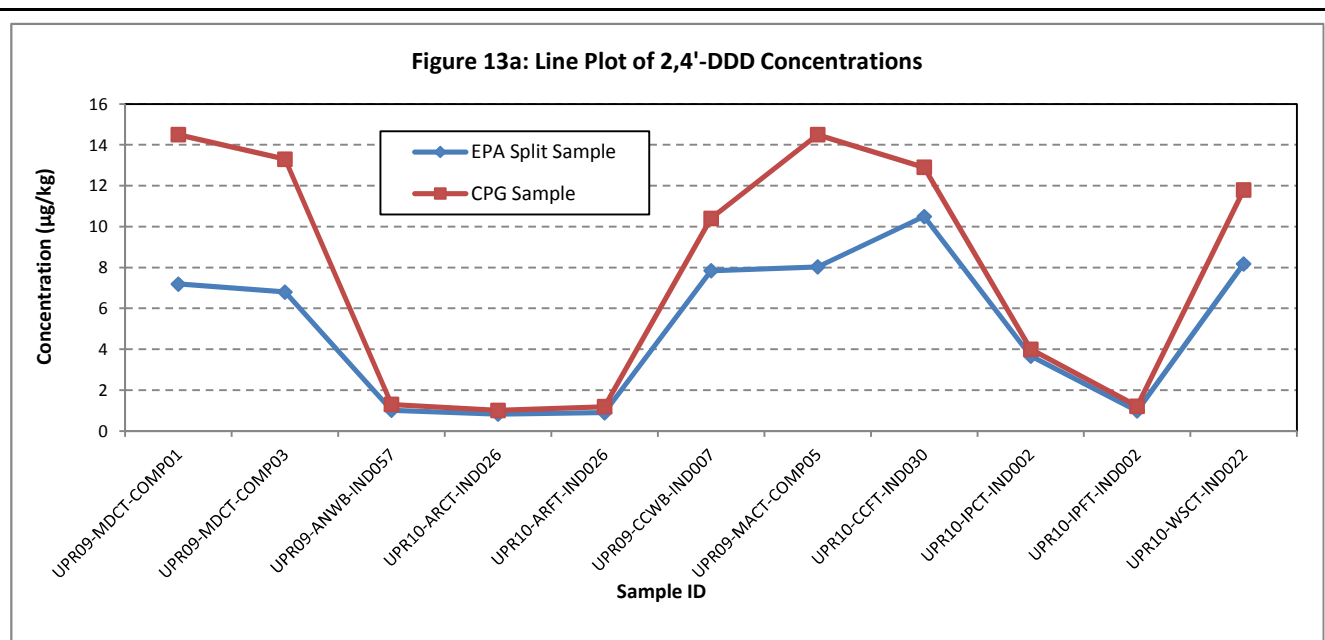


Figure 12c: Line Plot of alpha-Chlordane Percent Differences when EPA and CPG both had Detected Concentrations

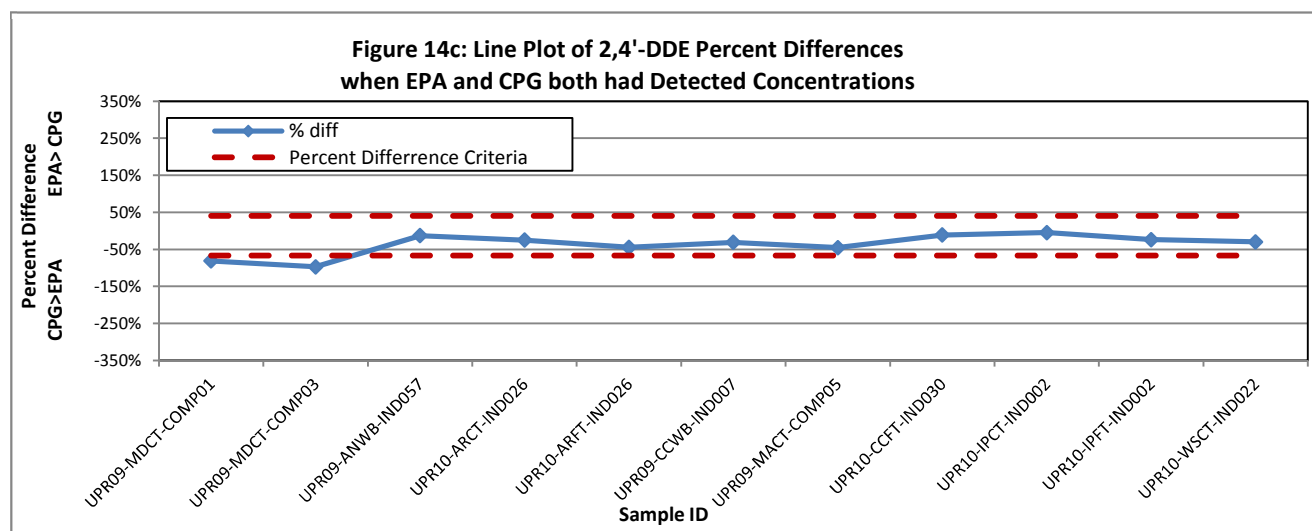
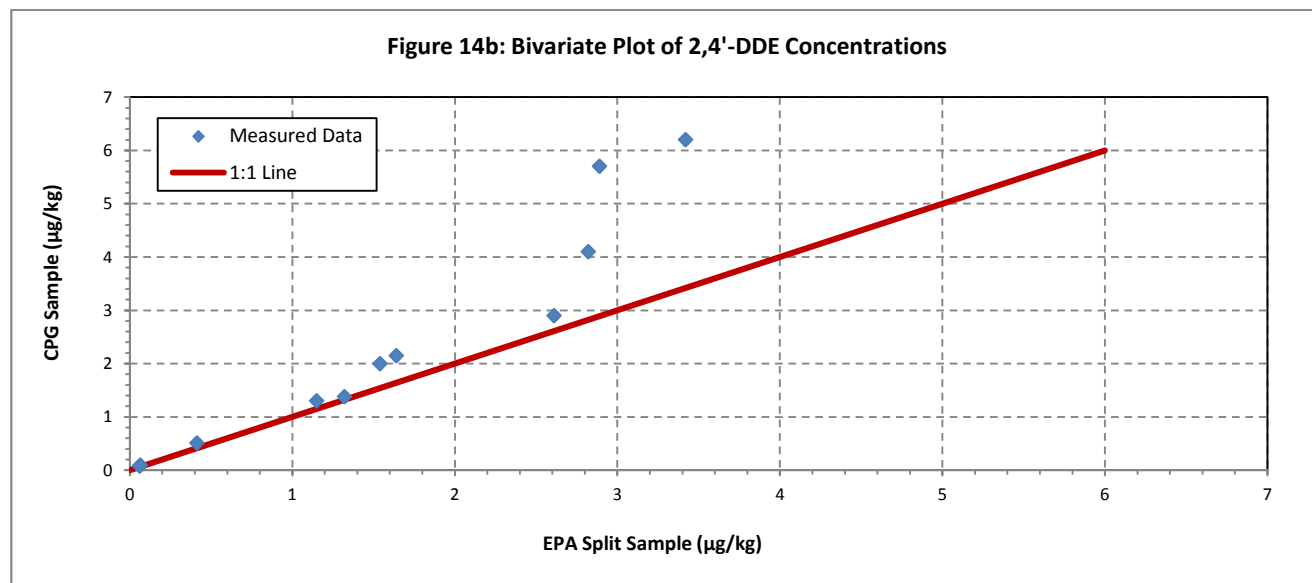
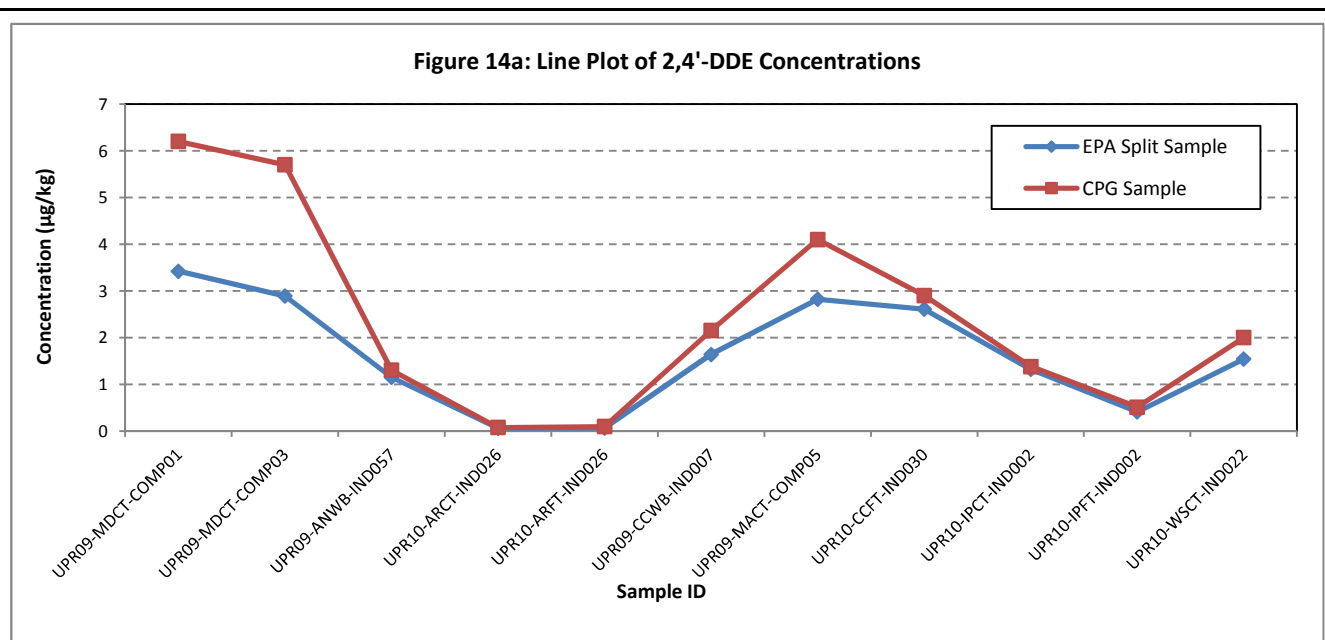




Statistical Plot of 2,4'-DDD Concentrations

Figure 13

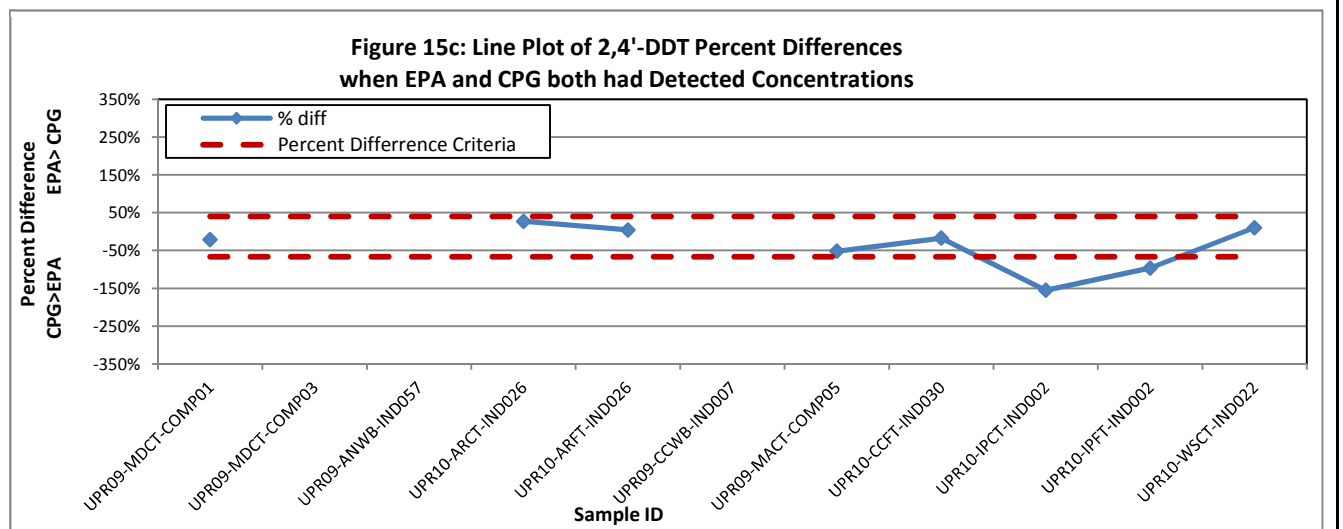
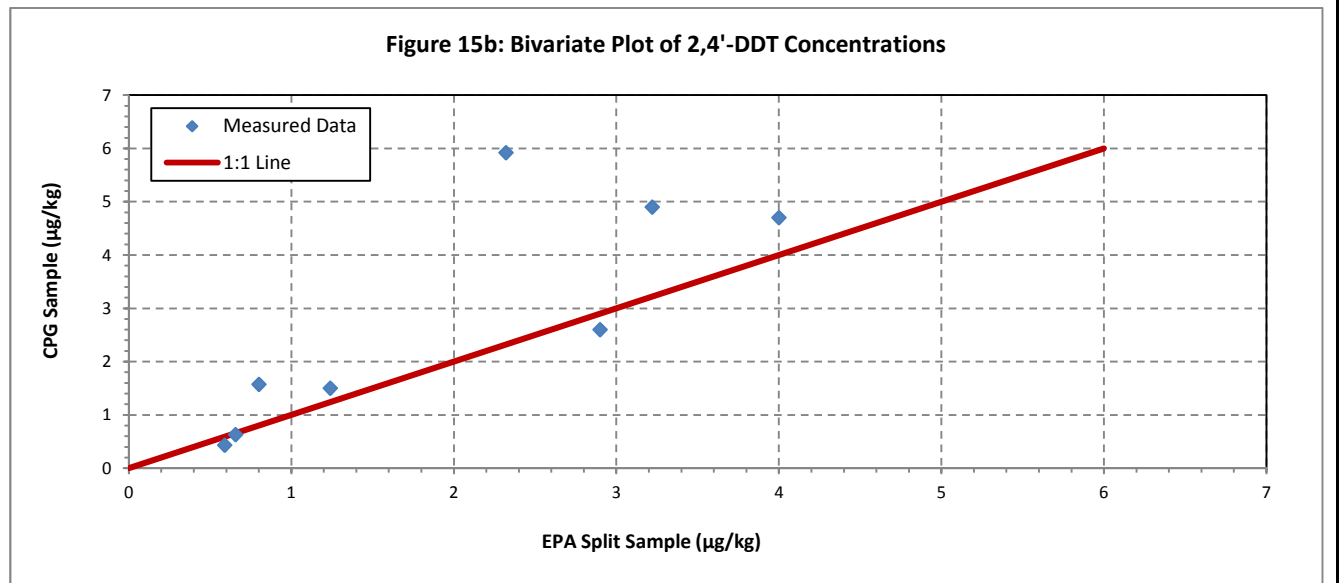
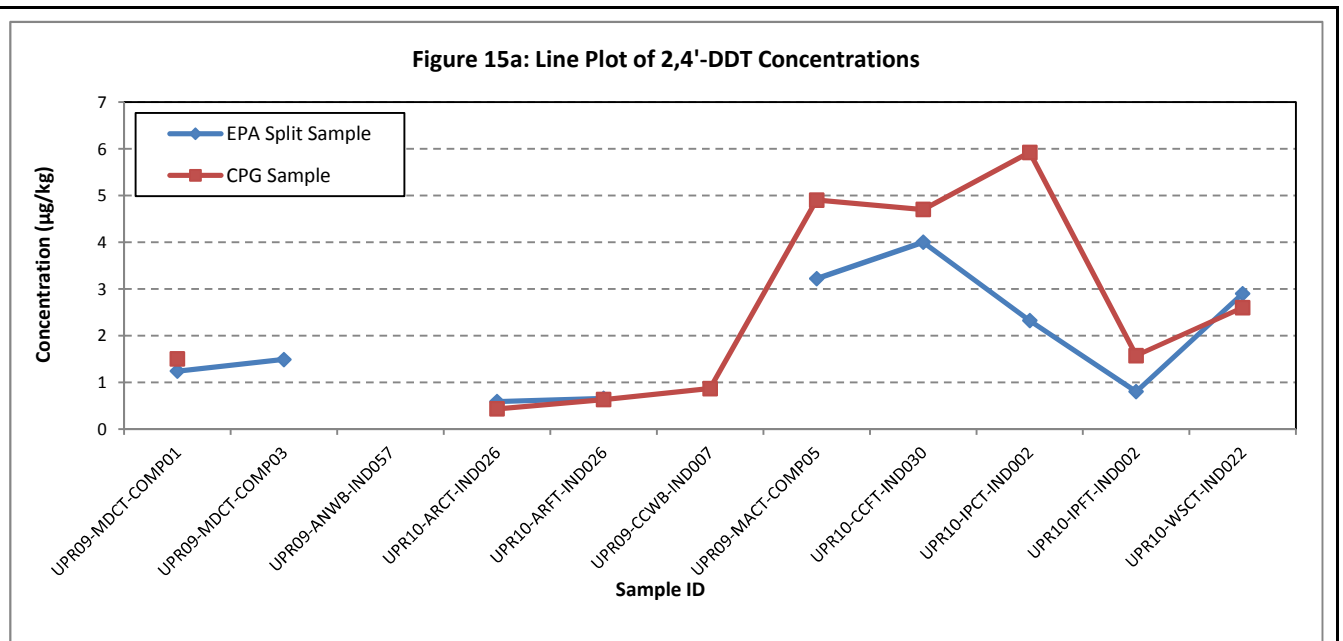
2,4'-DDD = 2,4'-dichlorodiphenyldichloroethane



Statistical Plot of 2,4'-DDE Concentrations

Figure 14

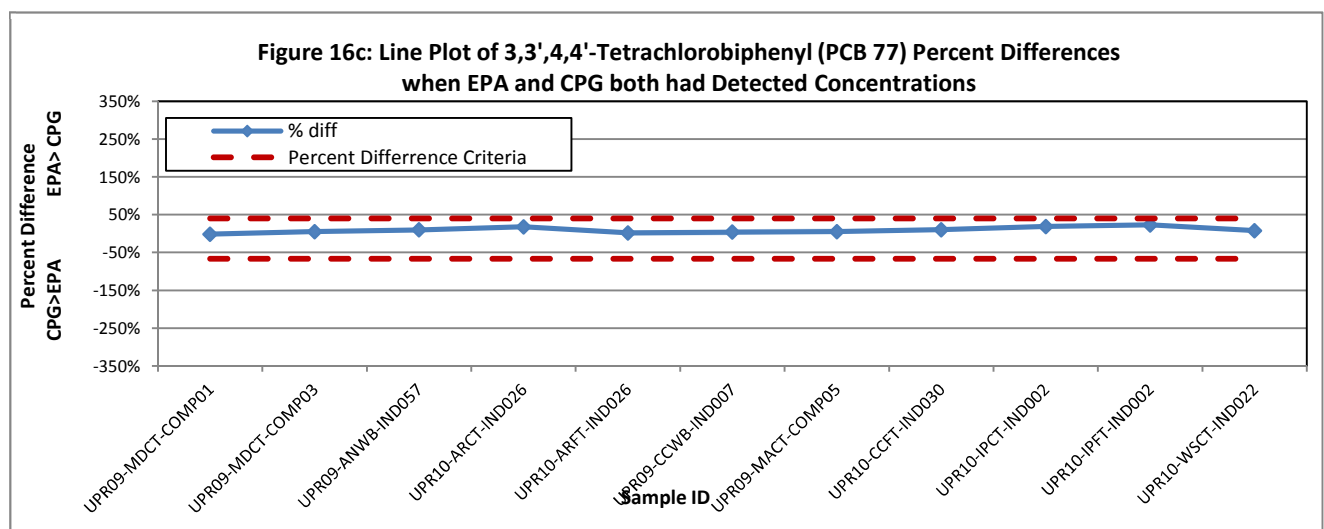
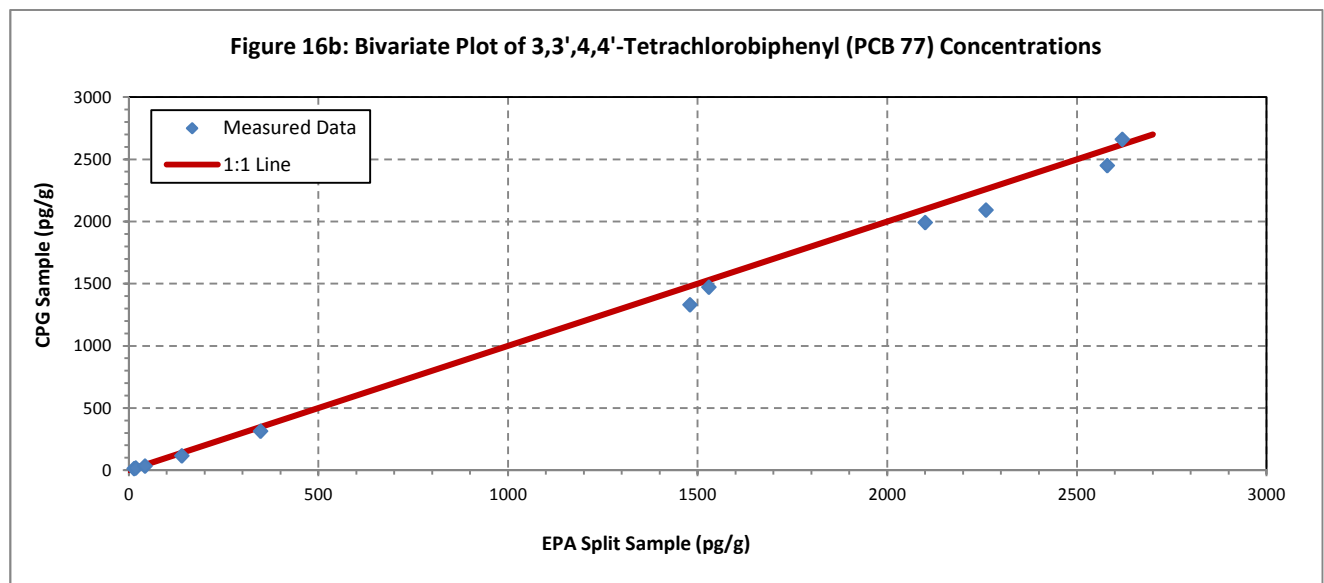
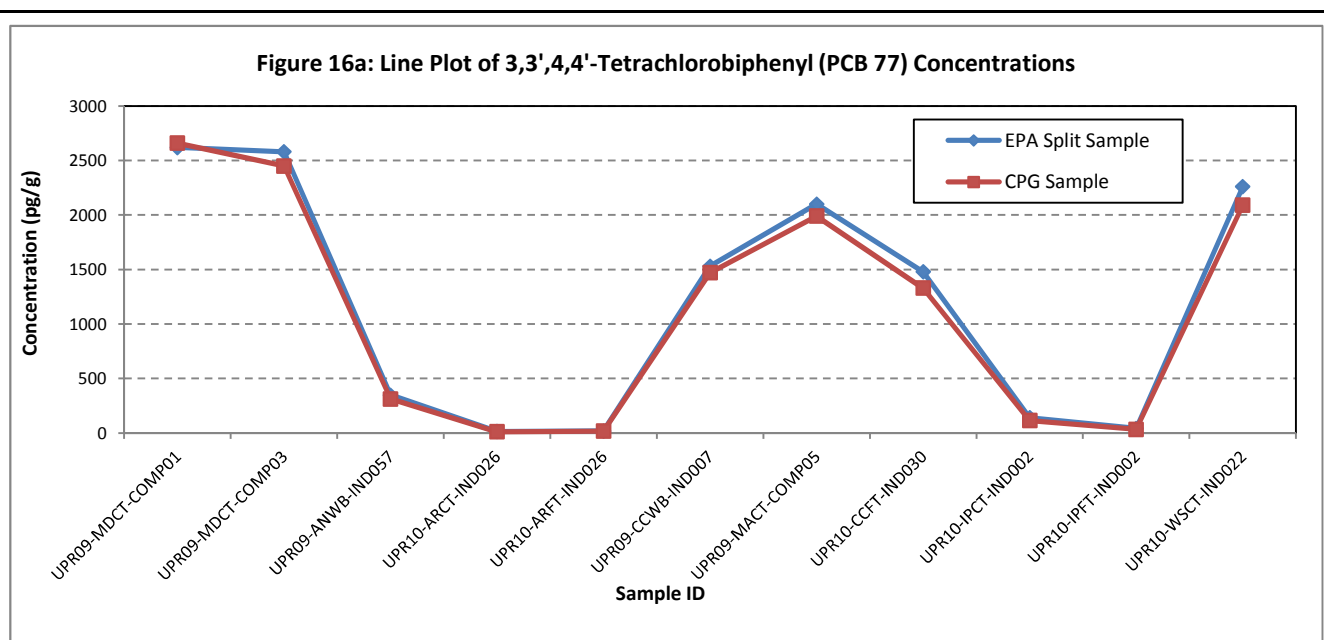
2,4'-DDE = 2,4'-dichlorodiphenyldichloroethylene



Statistical Plot of 2,4'-DDT Concentrations

Figure 15

2,4'-DDT = 2,4'-dichlorodiphenyltrichloroethane



PCB = polychlorinated biphenyl

Figure 17a: Line Plot of 3,4,4',5-Tetrachlorobiphenyl (PCB 81) Concentrations

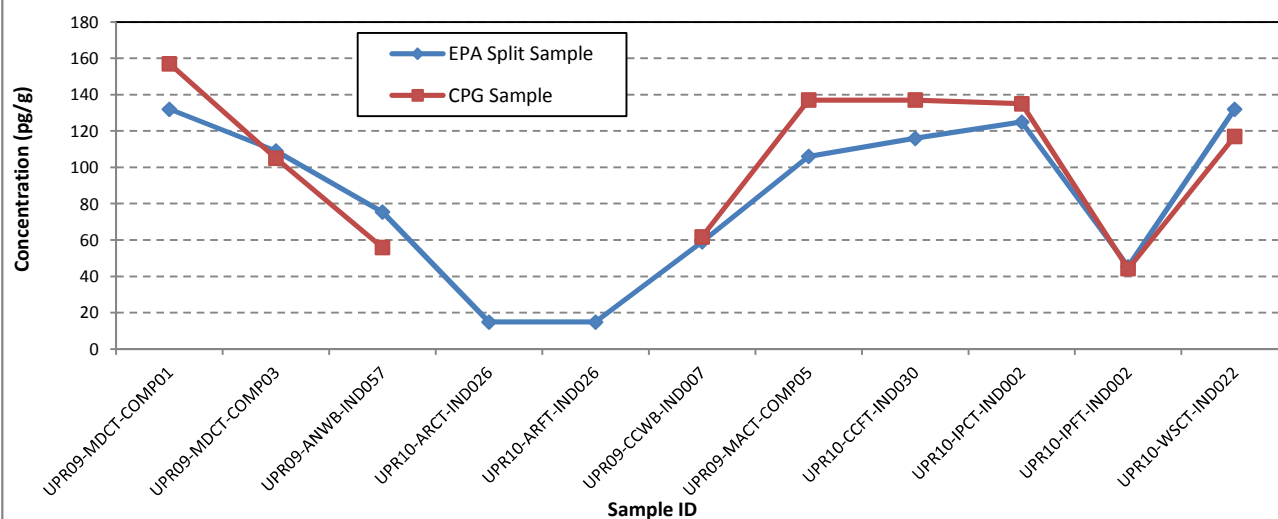


Figure 17b: Bivariate Plot of 3,4,4',5-Tetrachlorobiphenyl (PCB 81) Concentrations

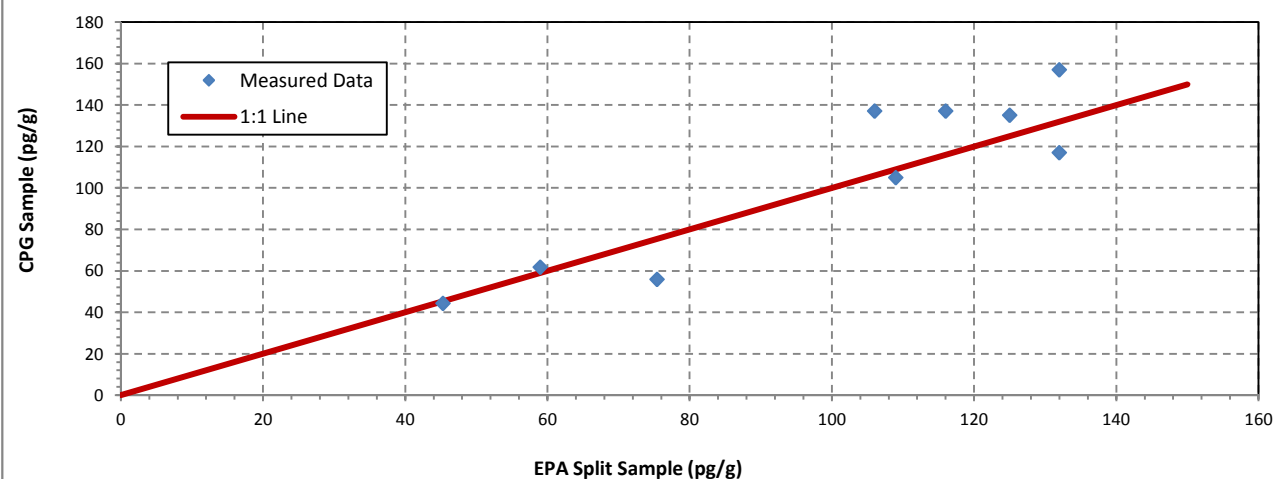
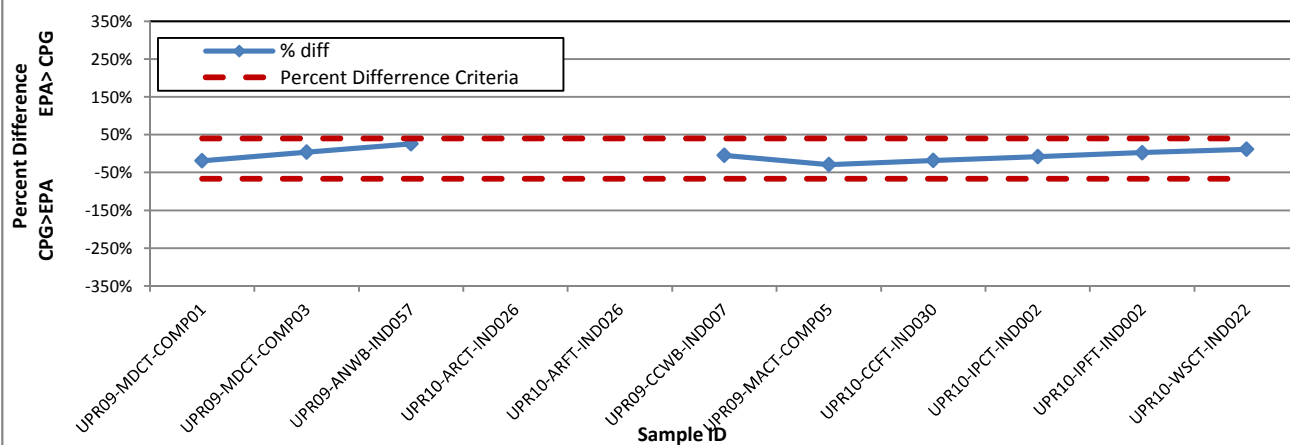


Figure 17c: Line Plot of 3,4,4',5-Tetrachlorobiphenyl (PCB 81) Percent Differences when EPA and CPG both had Detected Concentrations



Statistical Plot of 3,4,4',5-Tetrachlorobiphenyl (PCB 81)
Concentrations

Figure 17

PCB = polychlorinated biphenyl

Figure 18a: Line Plot of 2,3,3',4,4'-Pentachlorobiphenyl (PCB 105) Concentrations

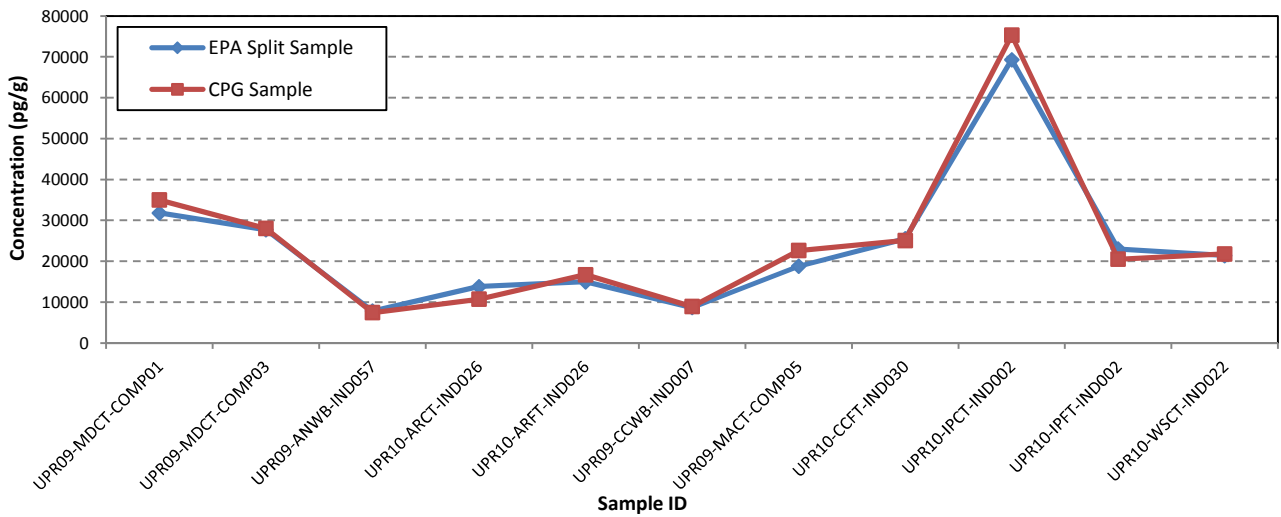


Figure 18b: Bivariate Plot of 2,3,3',4,4'-Pentachlorobiphenyl (PCB 105) Concentrations

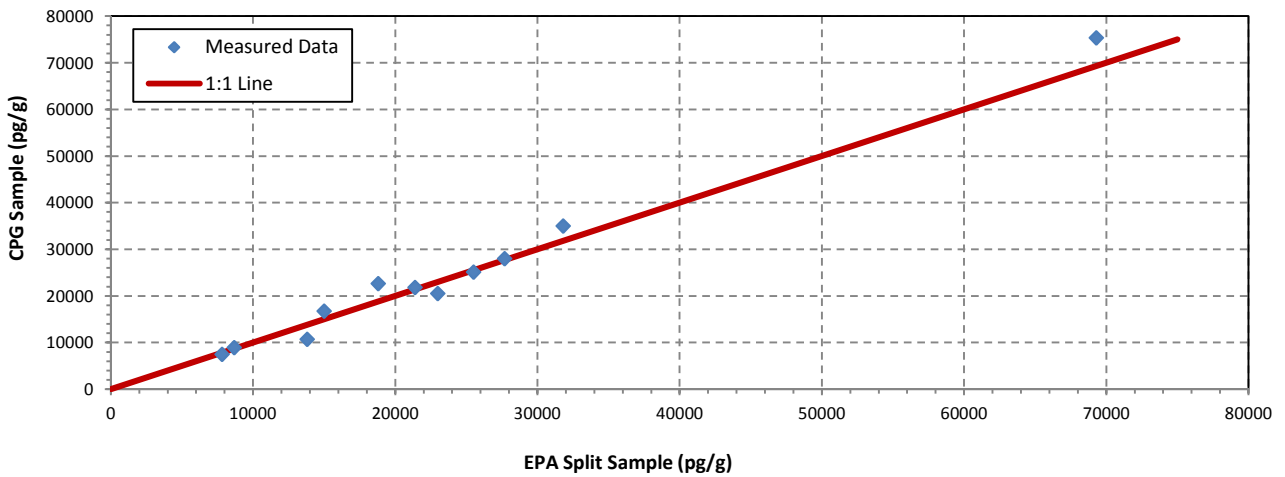
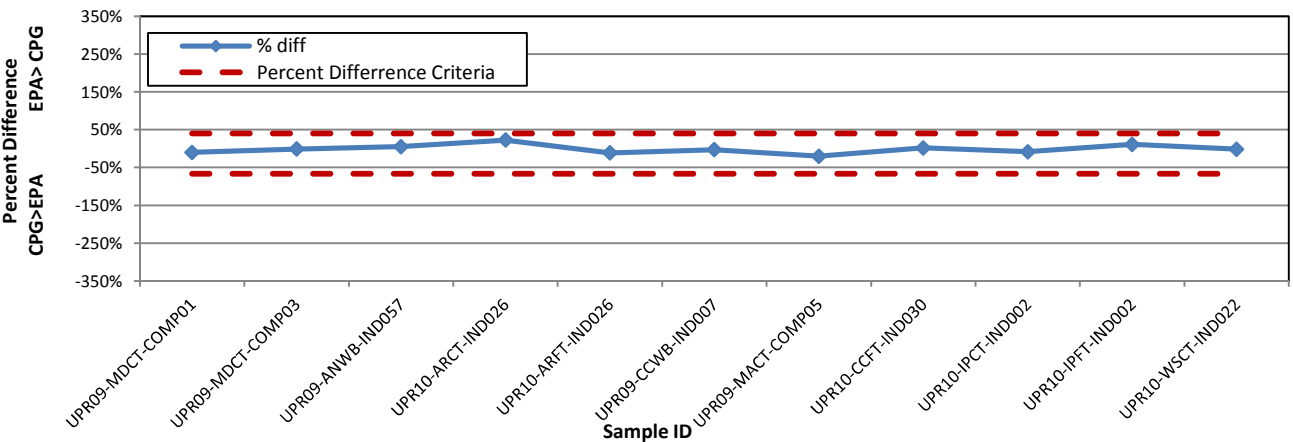


Figure 18c: Line Plot of 2,3,3',4,4'-Pentachlorobiphenyl (PCB 105) Percent Differences when EPA and CPG both had Detected Concentrations



Statistical Plot of 2,3,3',4,4'-Pentachlorobiphenyl (PCB 105) Concentrations

Figure 18

PCB = polychlorinated biphenyl

Figure 19a: Line Plot of 2,3,4,4',5-Pentachlorobiphenyl (PCB 114) Concentrations

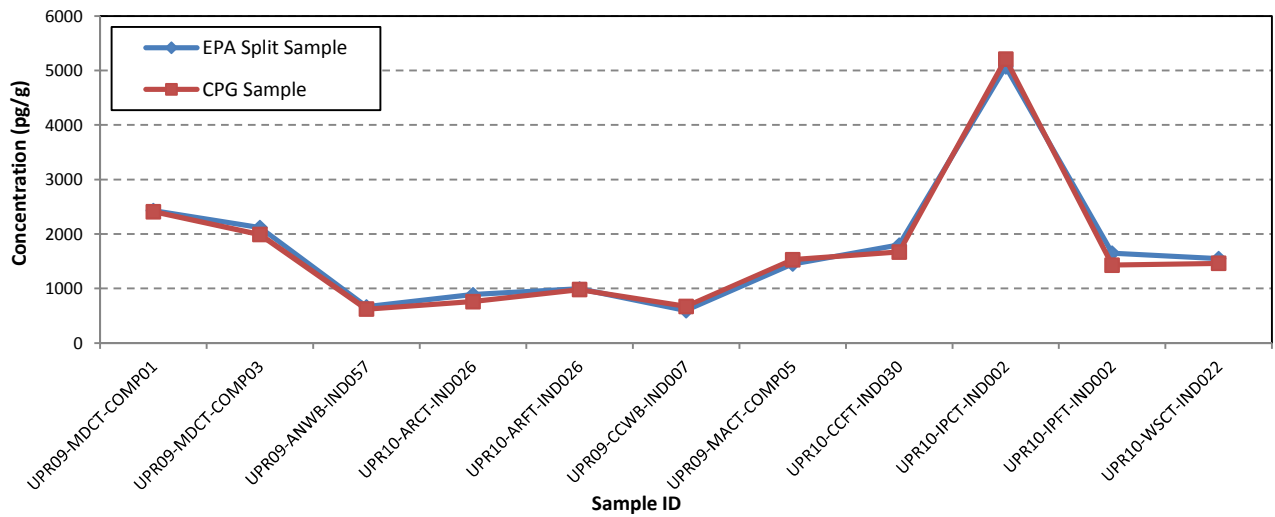


Figure 19b: Bivariate Plot of 2,3,4,4',5-Pentachlorobiphenyl (PCB 114) Concentrations

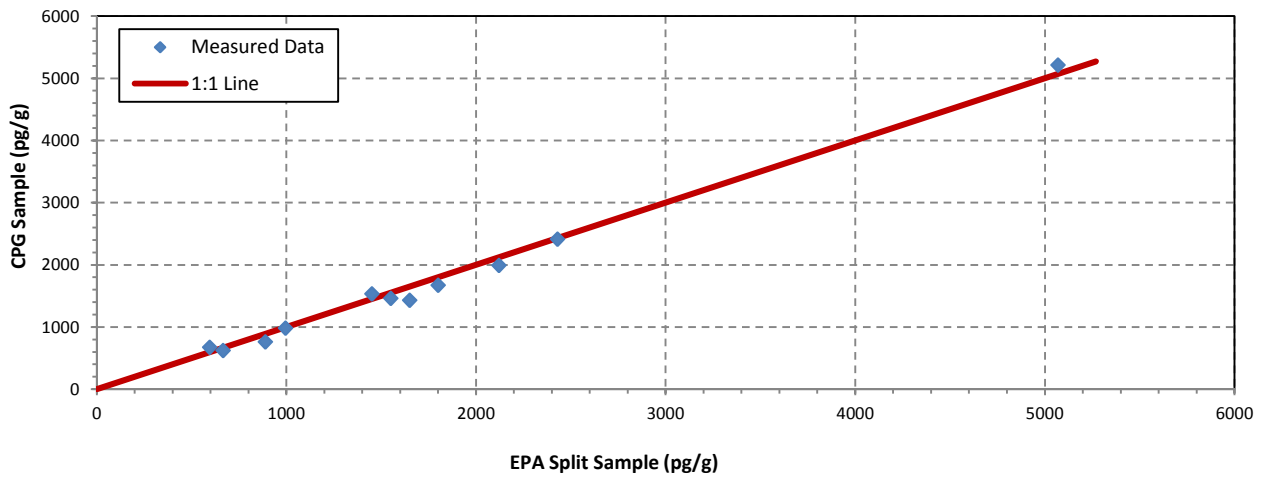
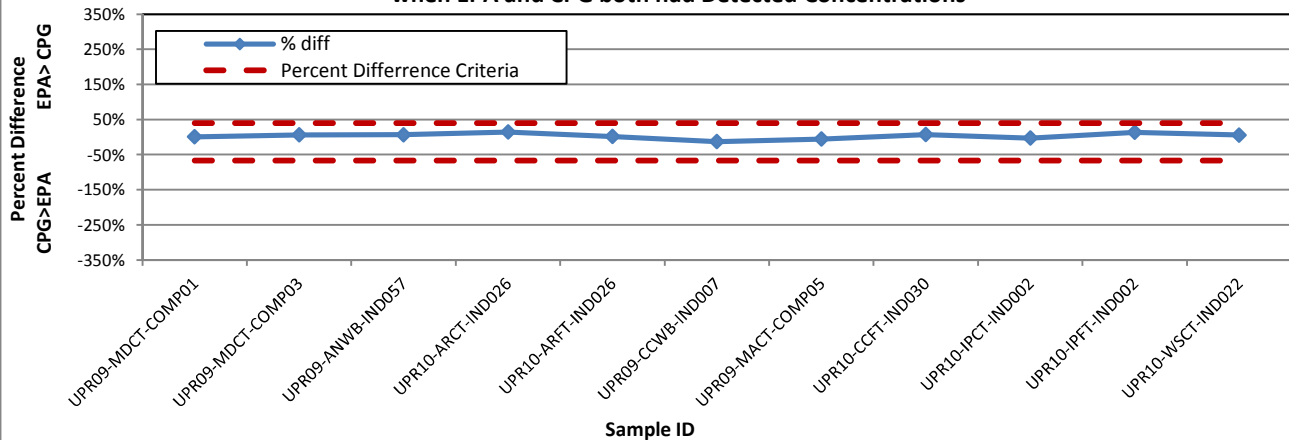


Figure 19c: Line Plot of 2,3,4,4',5-Pentachlorobiphenyl (PCB 114) Percent Differences when EPA and CPG both had Detected Concentrations



Statistical Plot of 2,3,4,4',5-Pentachlorobiphenyl (PCB 114) Concentrations

Figure 19

PCB = polychlorinated biphenyl

Figure 20a: Line Plot of 2,3',4,4',5-Pentachlorobiphenyl (PCB 118) Concentrations

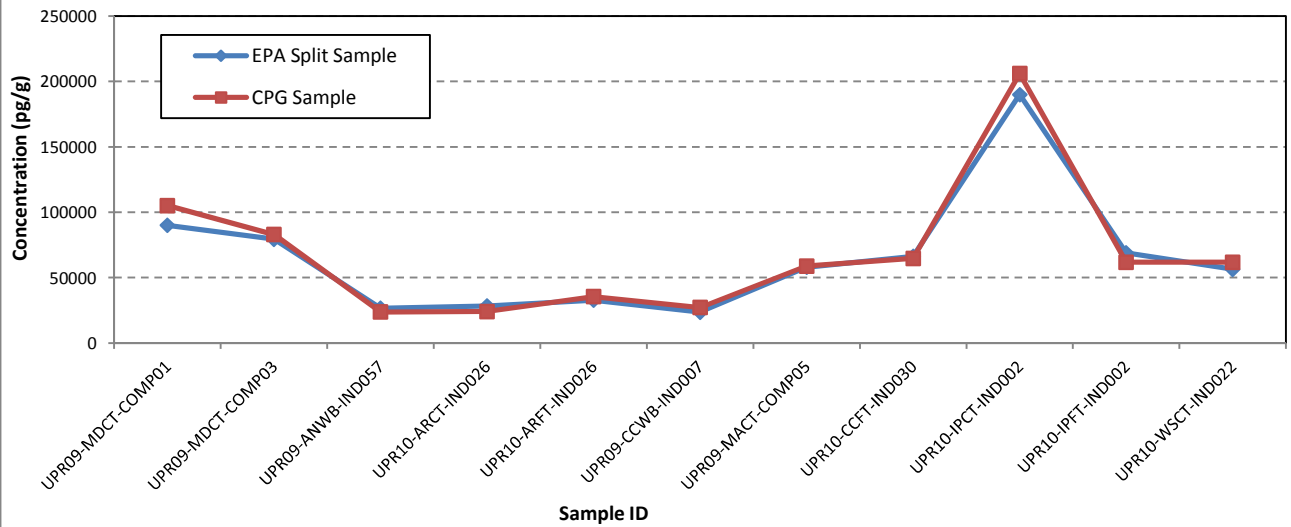


Figure 20b: Bivariate Plot of 2,3',4,4',5-Pentachlorobiphenyl (PCB 118) Concentrations

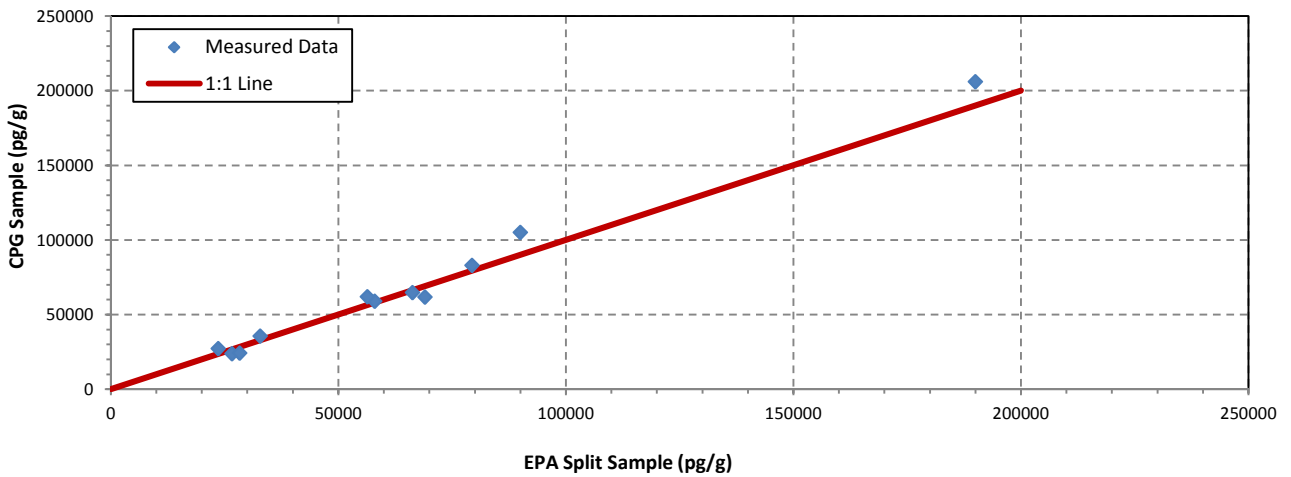
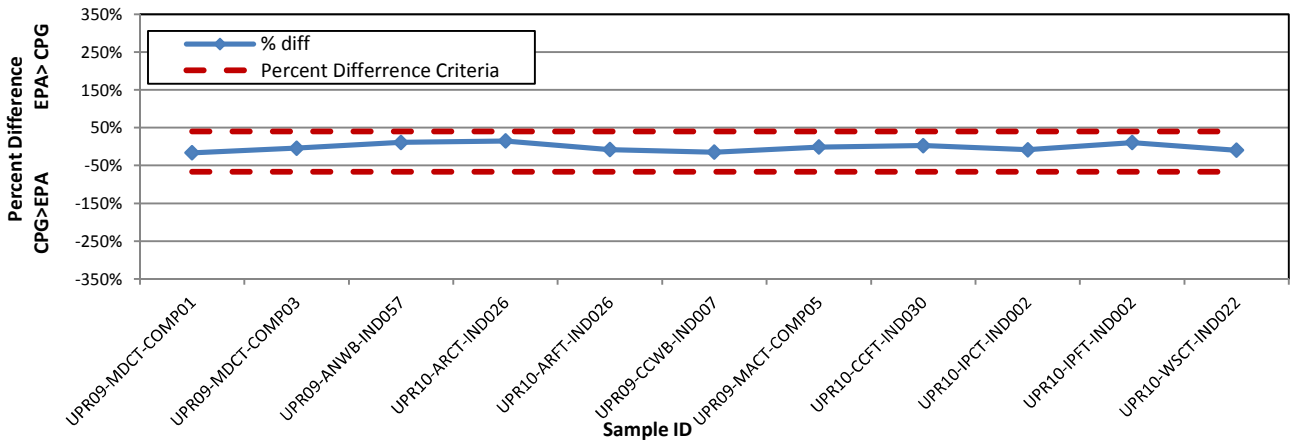


Figure 20c: Line Plot of 2,3',4,4',5-Pentachlorobiphenyl (PCB 118) Percent Differences when EPA and CPG both had Detected Concentrations



Statistical Plot of 2,3',4,4',5-Pentachlorobiphenyl (PCB 118) Concentrations

Figure 20

PCB = polychlorinated biphenyl

Figure 21a: Line Plot of 2',3,4,4',5-Pentachlorobiphenyl (PCB 123) Concentrations

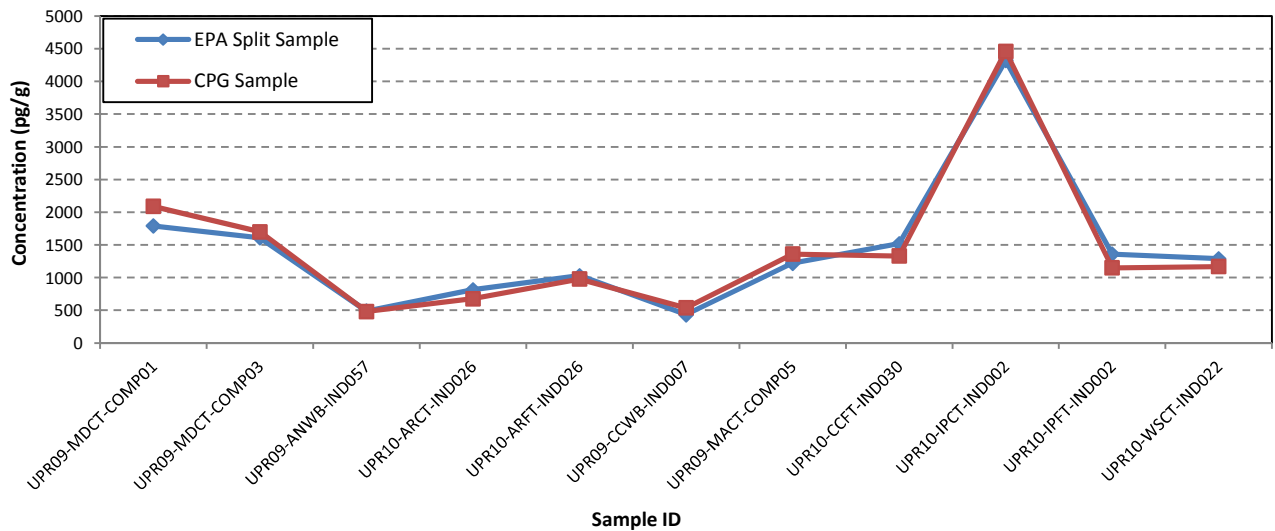


Figure 21b: Bivariate Plot of 2',3,4,4',5-Pentachlorobiphenyl (PCB 123) Concentrations

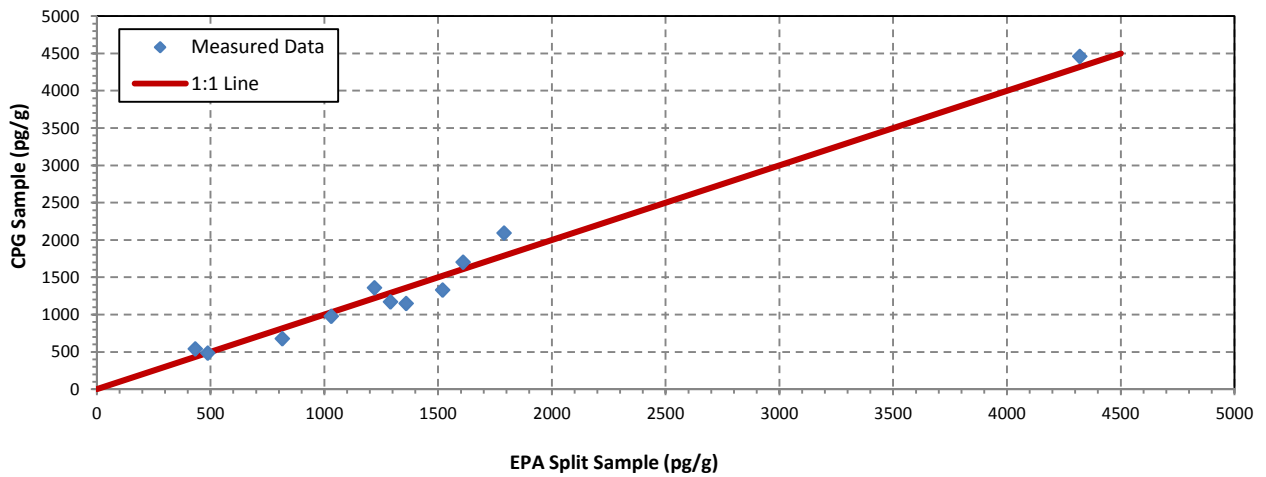
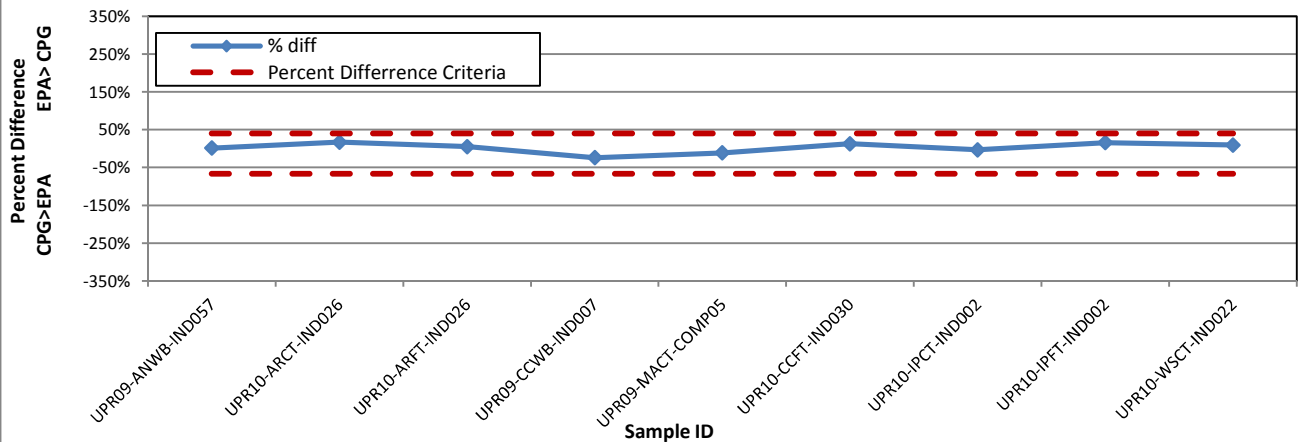


Figure 21c: Line Plot of 2',3,4,4',5-Pentachlorobiphenyl (PCB 123) Percent Differences when EPA and CPG both had Detected Concentrations



Statistical Plot of 2,3',4,4',5'-Pentachlorobiphenyl (PCB 123) Concentrations

Figure 21

PCB = polychlorinated biphenyl

Figure 22a: Line Plot of 3,3',4,4',5-Pentachlorobiphenyl (PCB 126) Concentrations

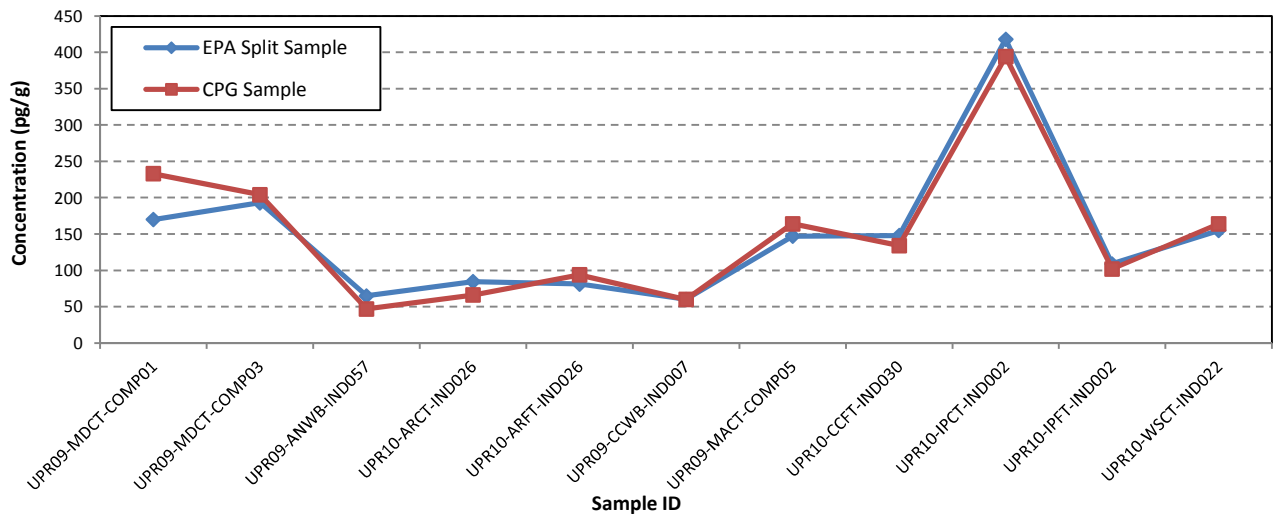


Figure 22b: Bivariate Plot of 3,3',4,4',5-Pentachlorobiphenyl (PCB 126) Concentrations

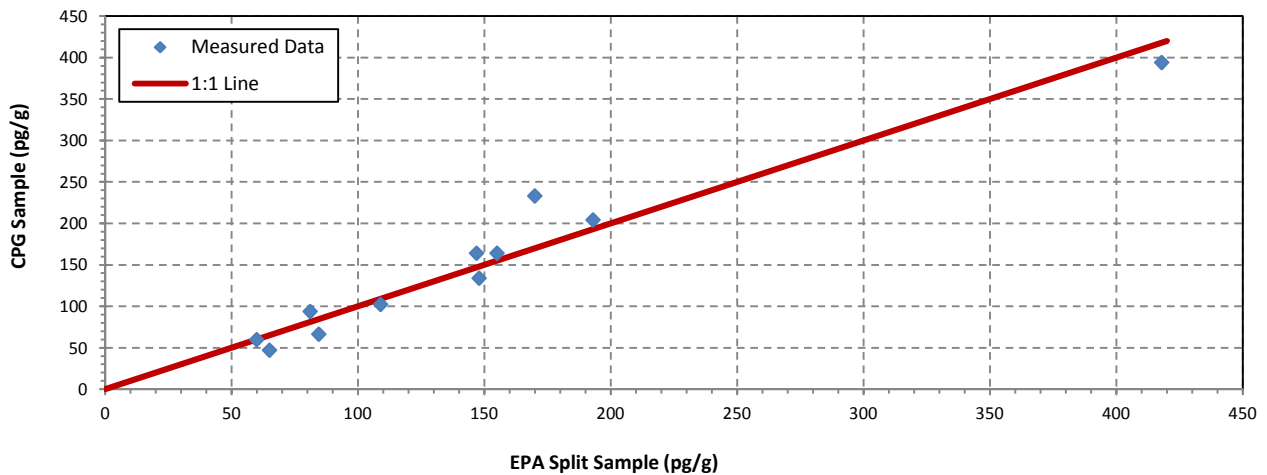
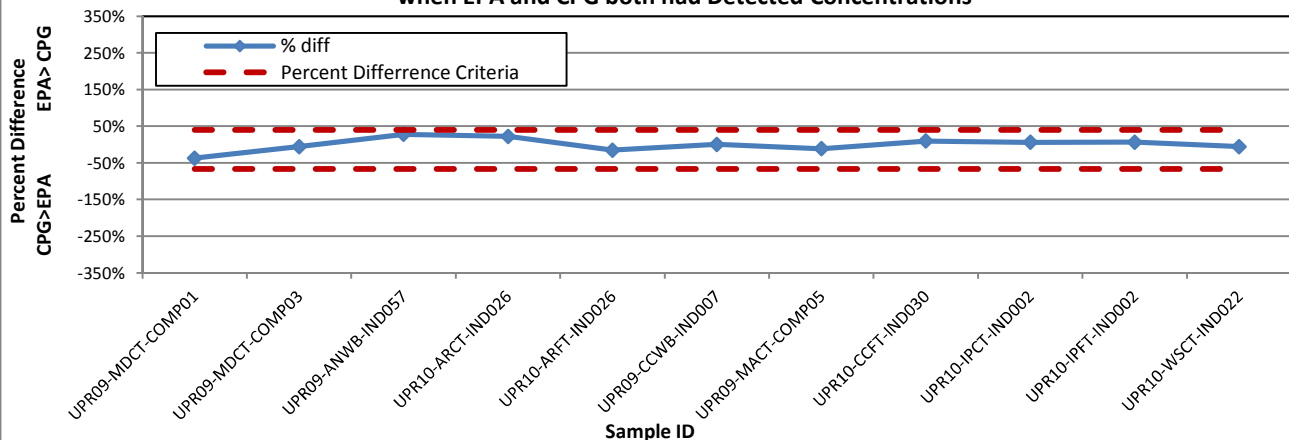


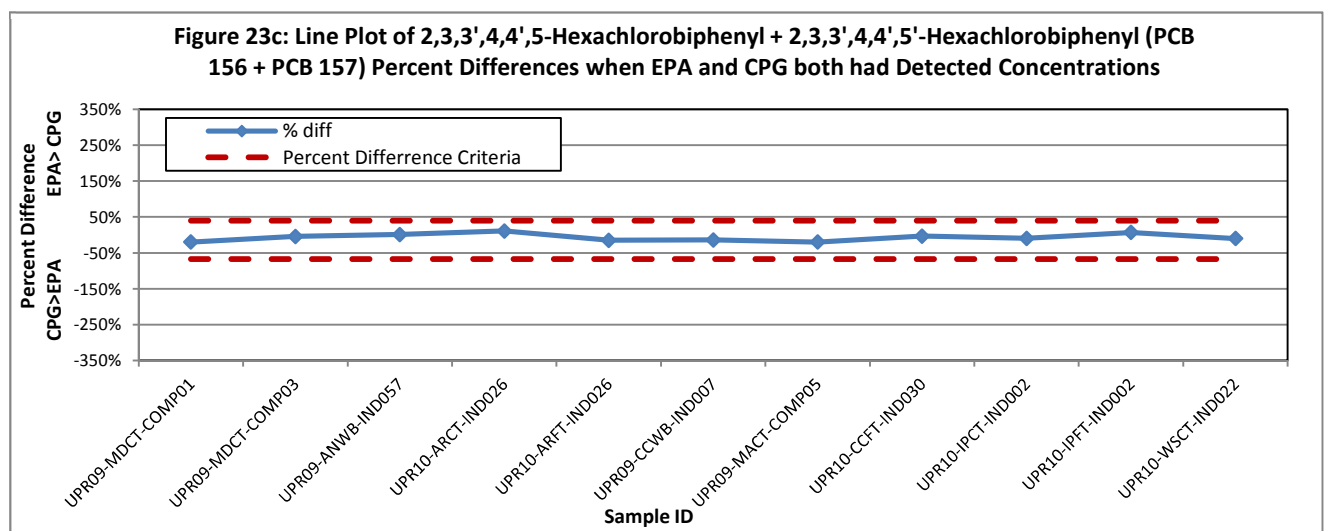
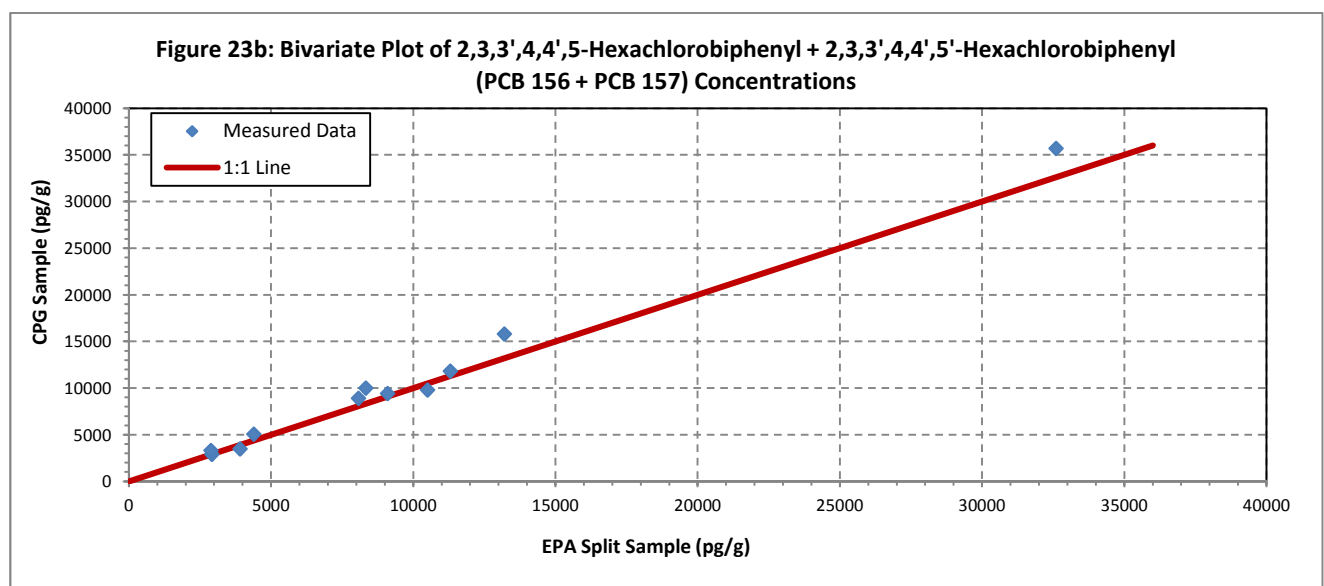
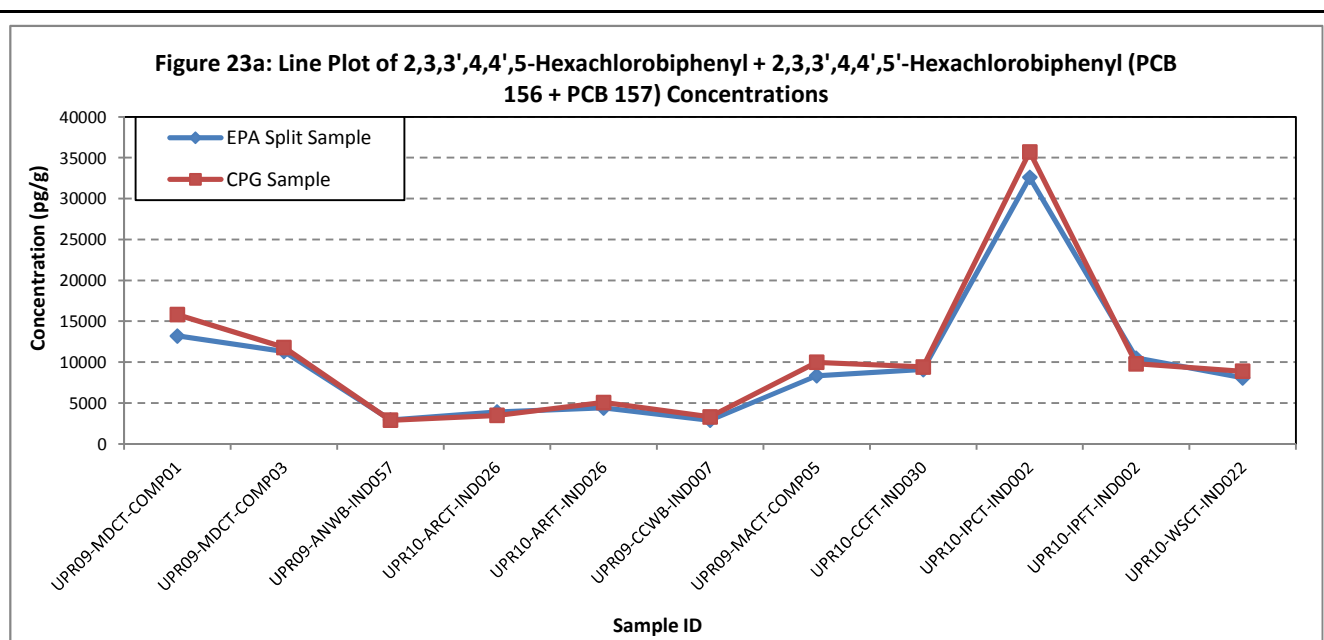
Figure 22c: Line Plot of 3,3',4,4',5-Pentachlorobiphenyl (PCB 126) Percent Differences when EPA and CPG both had Detected Concentrations



Statistical Plot of 3,3',4,4',5-Pentachlorobiphenyl (PCB 126) Concentrations

Figure 22

PCB = polychlorinated biphenyl



PCB = polychlorinated biphenyl

Figure 24a: Line Plot of 2,3',4,4',5,5'-Hexachlorobiphenyl (PCB 167) Concentrations

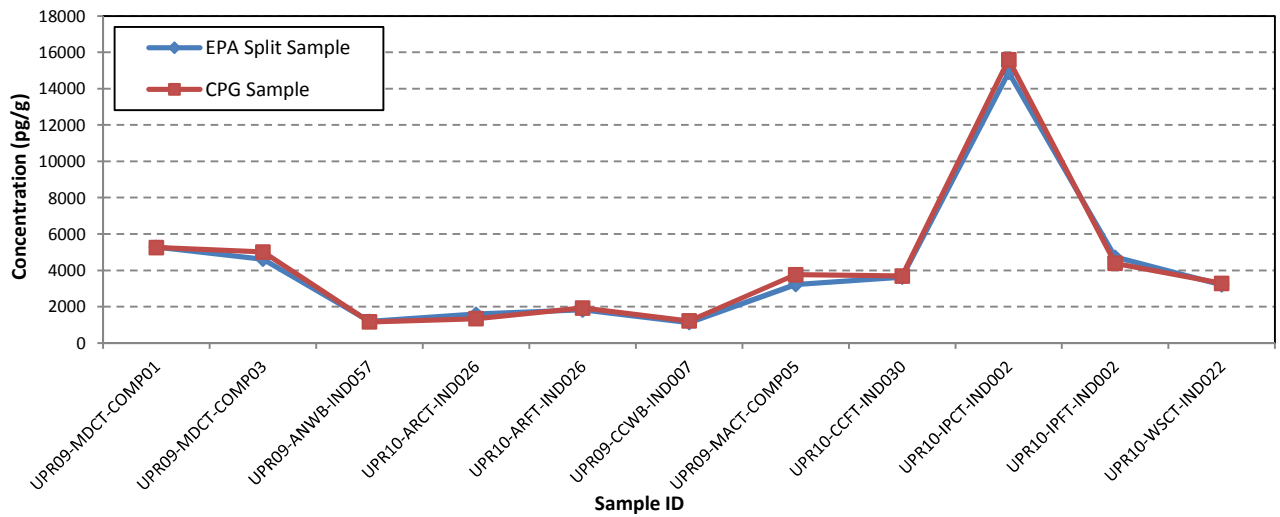


Figure 24b: Bivariate Plot of 2,3',4,4',5,5'-Hexachlorobiphenyl (PCB 167) Concentrations

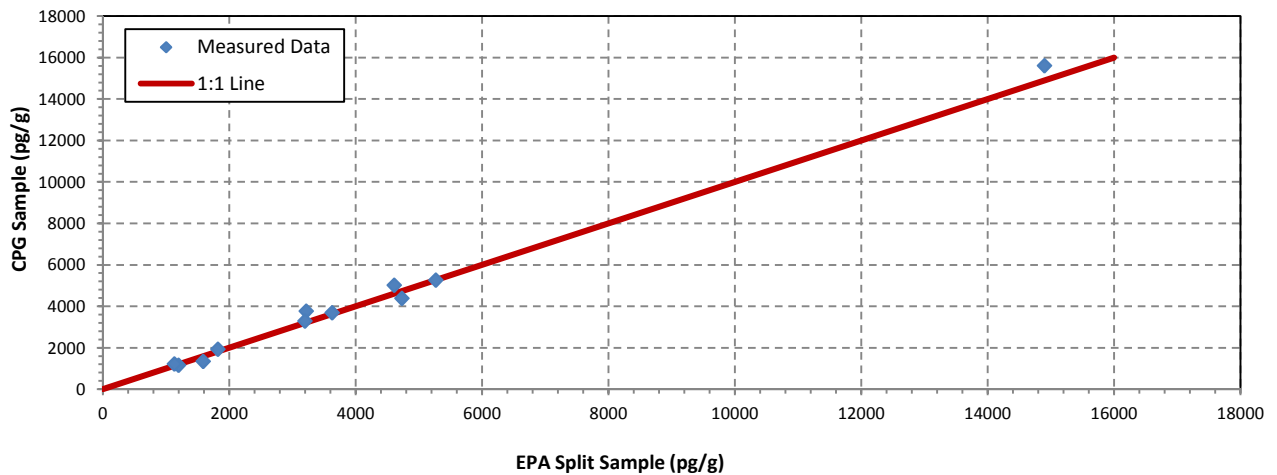
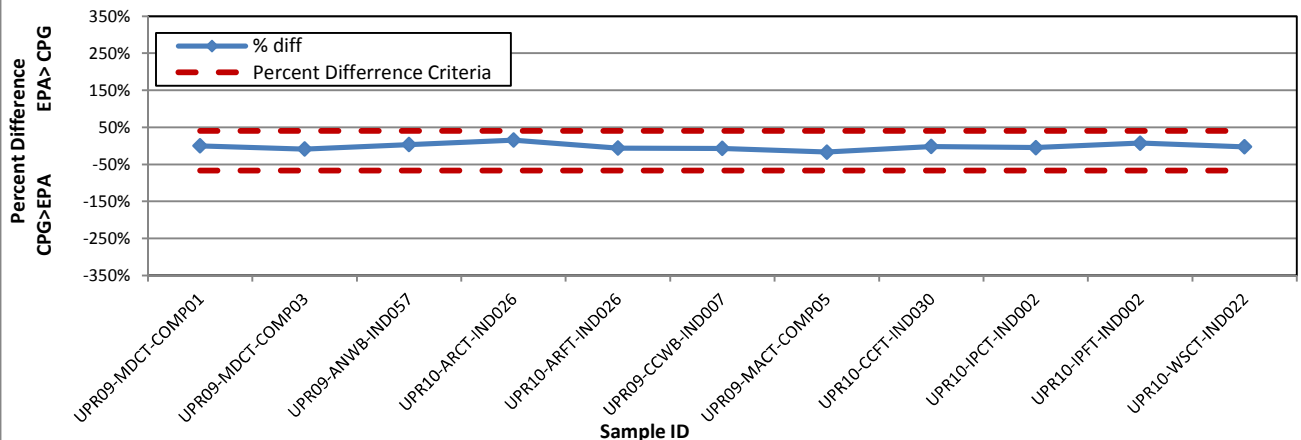


Figure 24c: Line Plot of 2,3',4,4',5,5'-Hexachlorobiphenyl (PCB 167) Percent Differences when EPA and CPG both had Detected Concentrations



Statistical Plot of 2,3',4,4',5,5'-Hexachlorobiphenyl (PCB 167) Concentrations

Figure 24

PCB = polychlorinated biphenyl

Figure 25a: Line Plot of 3,3',4,4',5,5'-Hexachlorobiphenyl (PCB 169) Concentrations

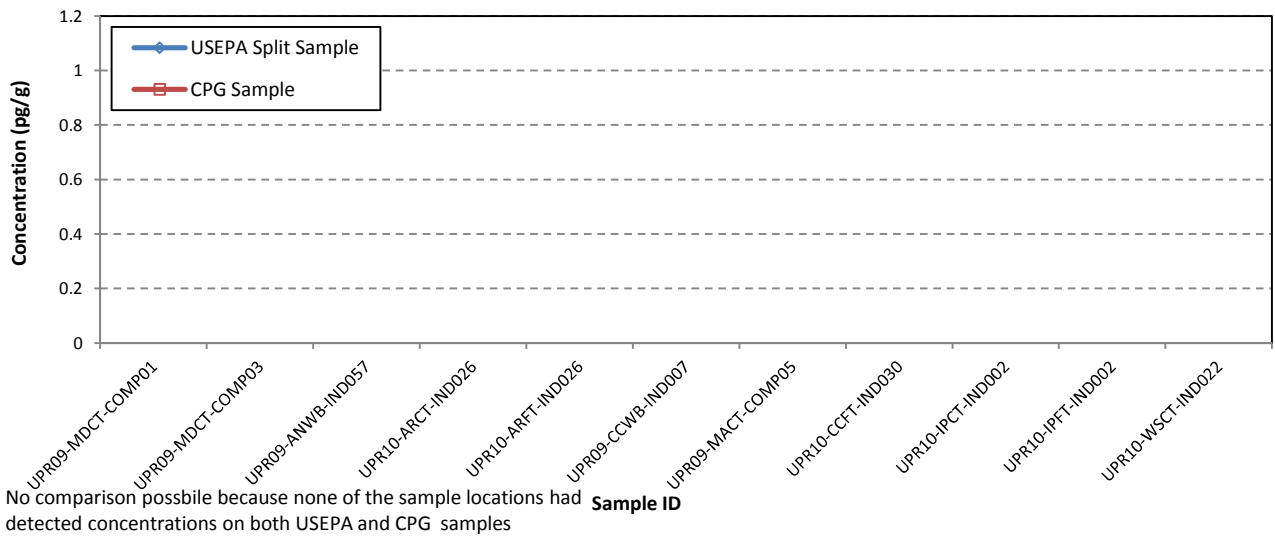


Figure 25b: Bivariate Plot of 3,3',4,4',5,5'-Hexachlorobiphenyl (PCB 169) Concentrations

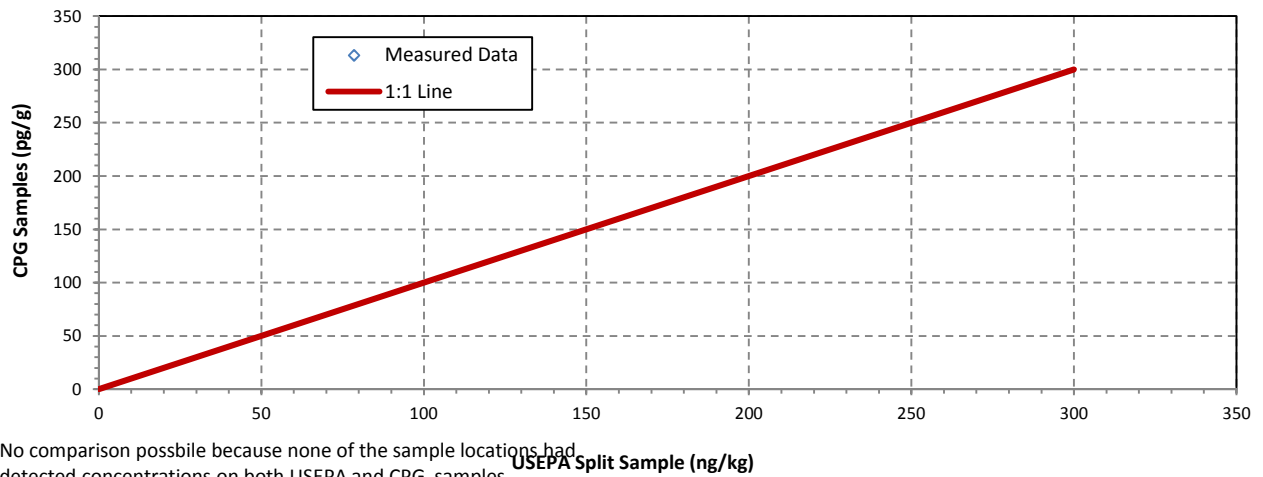
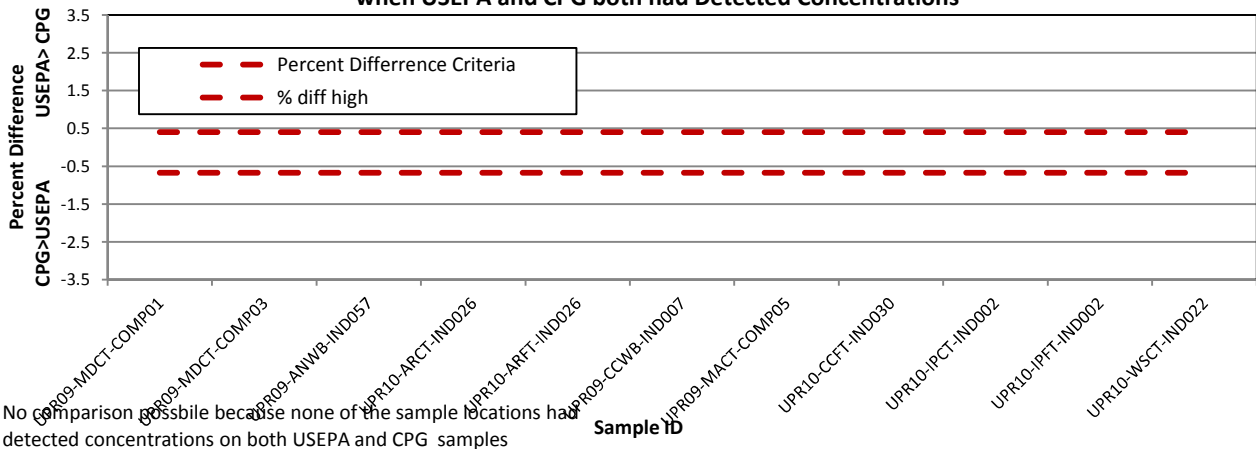


Figure 25c: Line Plot of 3,3',4,4',5,5'-Hexachlorobiphenyl (PCB 169) Percent Differences when USEPA and CPG both had Detected Concentrations



Statistical Plot of 3,3',4,4',5,5'-Hexachlorobiphenyl (PCB 169) Concentrations

Figure 25

PCB = polychlorinated biphenyl

Figure 26a: Line Plot of 2,3,3',4,4',5,5'-Heptachlorobiphenyl (PCB 189) Concentrations

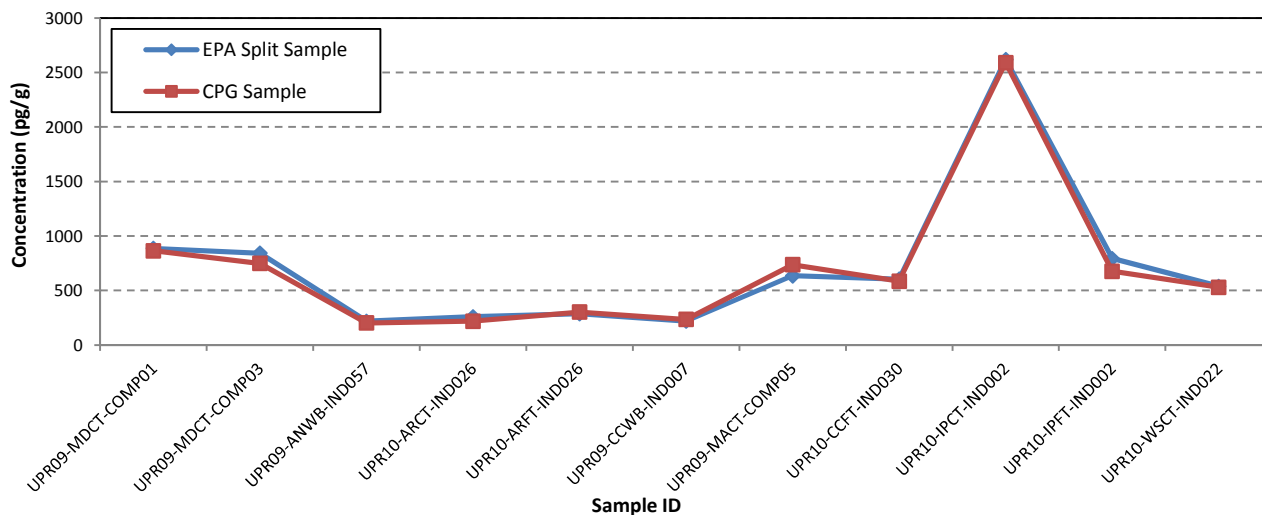


Figure 26b: Bivariate Plot of 2,3,3',4,4',5,5'-Heptachlorobiphenyl (PCB 189) Concentrations

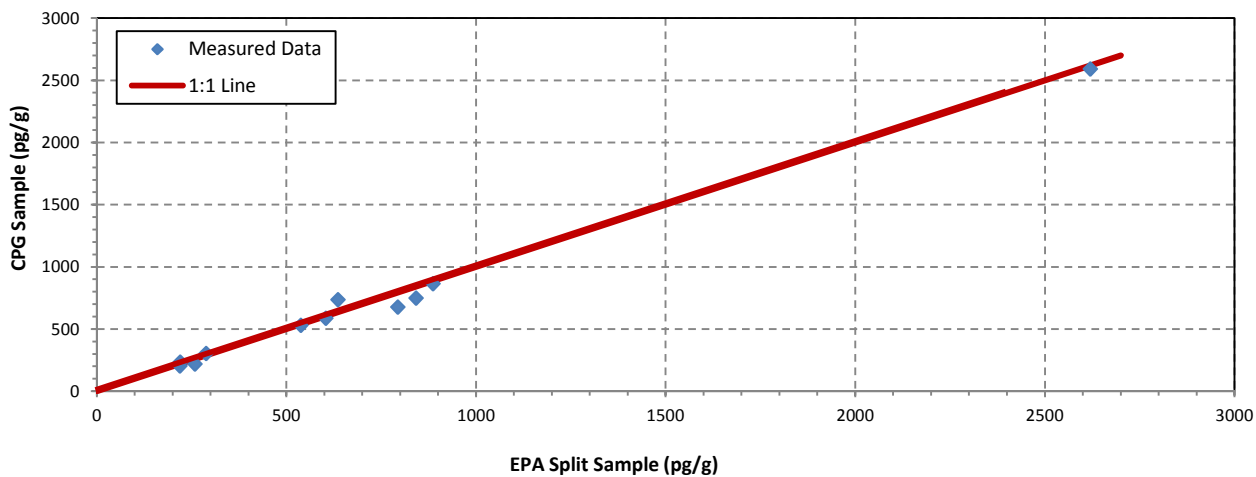
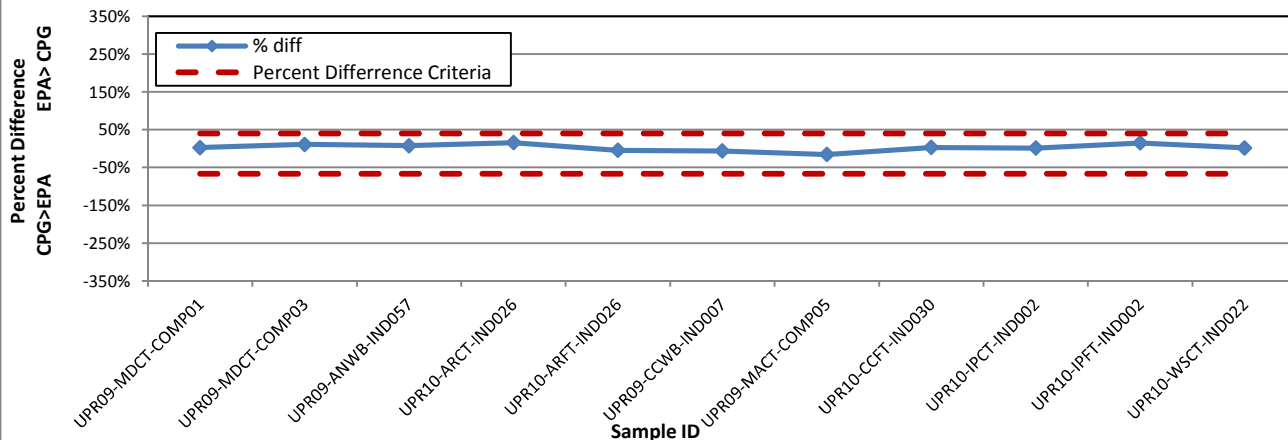


Figure 26c: Line Plot of 2,3,3',4,4',5,5'-Heptachlorobiphenyl (PCB 189) Percent Differences when EPA and CPG both had Detected Concentrations



Statistical Plot of 2,3,3',4,4',5,5'-Heptachlorobiphenyl (PCB 189) Concentrations

Figure 26

PCB = polychlorinated biphenyl

Figure 27a: Line Plot of Total PCBs Concentrations

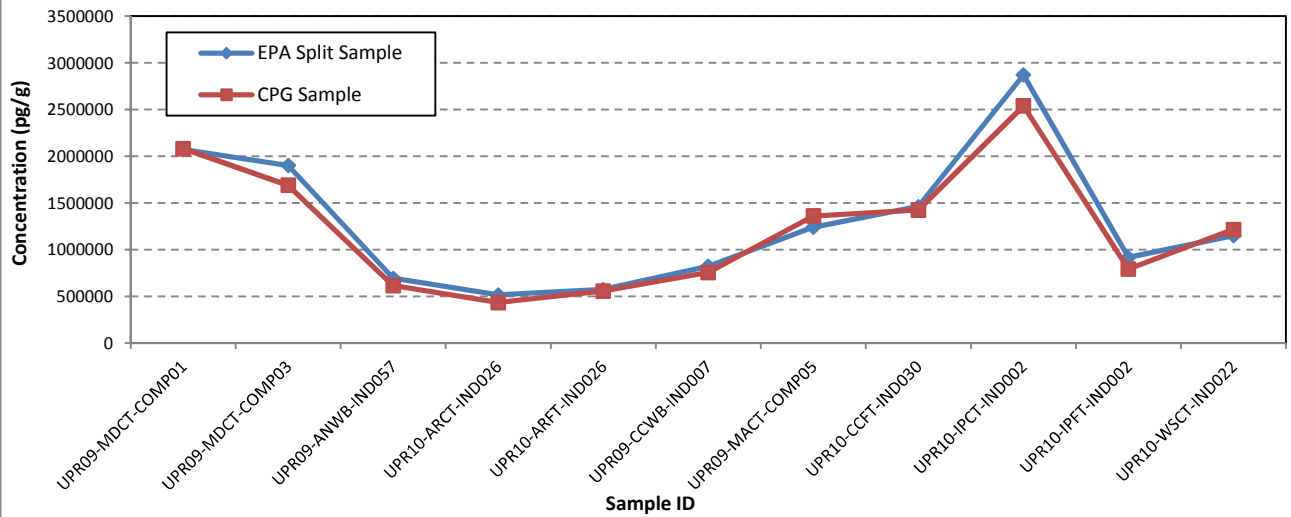


Figure 27b: Bivariate Plot of Total PCBs Concentrations

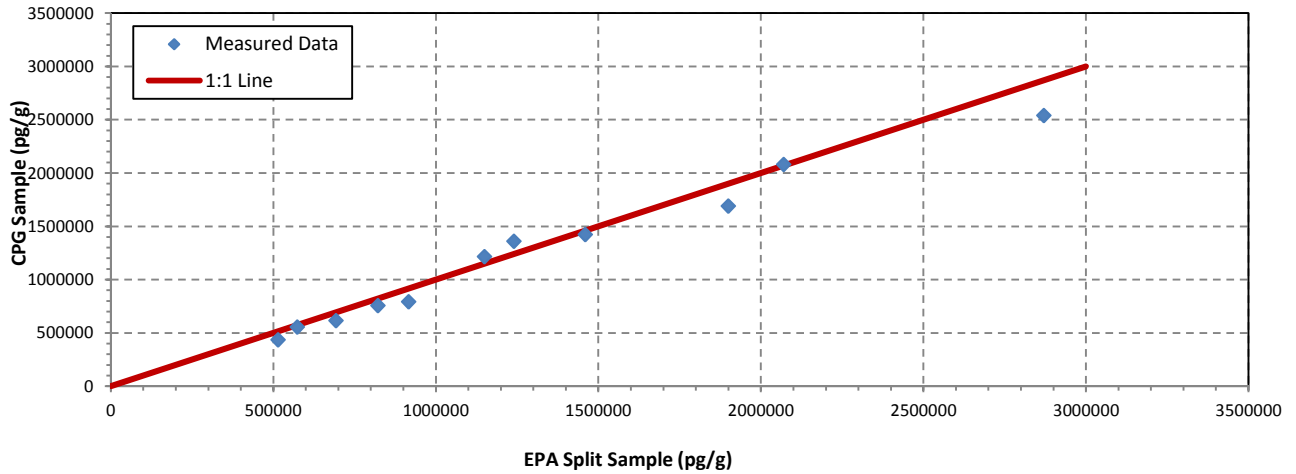
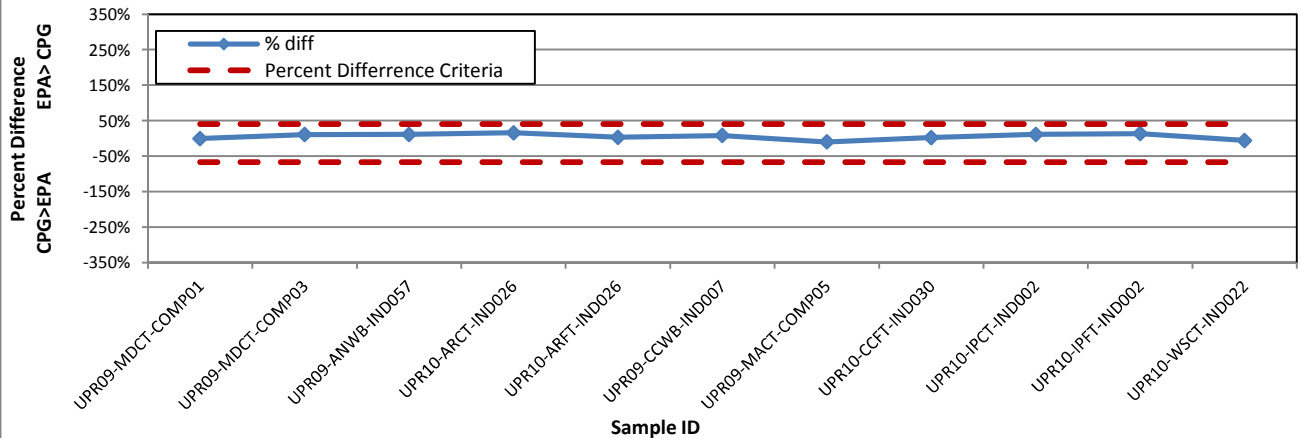


Figure 27c: Line Plot of Total PCBs Percent Differences when EPA and CPG both had Detected Concentrations



Statistical Plot of Total PCBs Concentrations

Figure 27

PCB = polychlorinated biphenyl

Figure 28a: Line Plot of Anthracene Concentrations

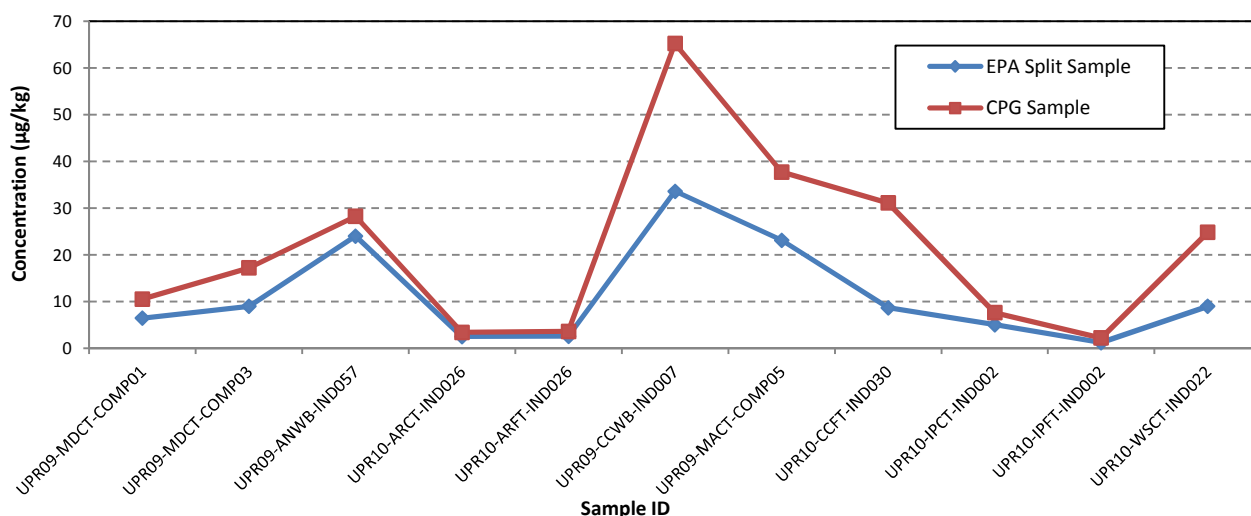


Figure 28b: Bivariate Plot of Anthracene Concentrations

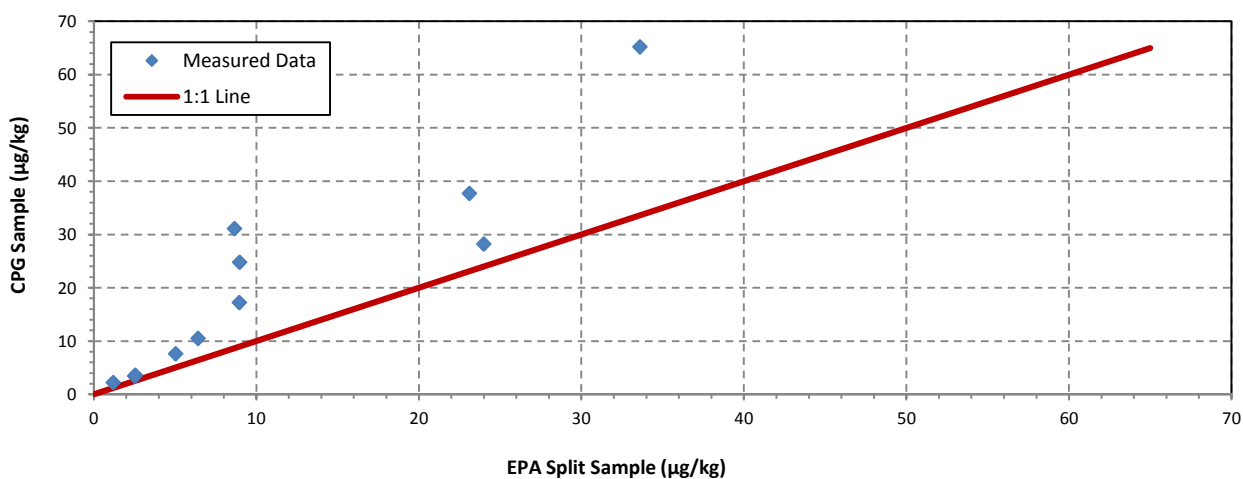


Figure 28c: Line Plot of Anthracene Percent Differences when EPA and CPG both had Detected Concentrations

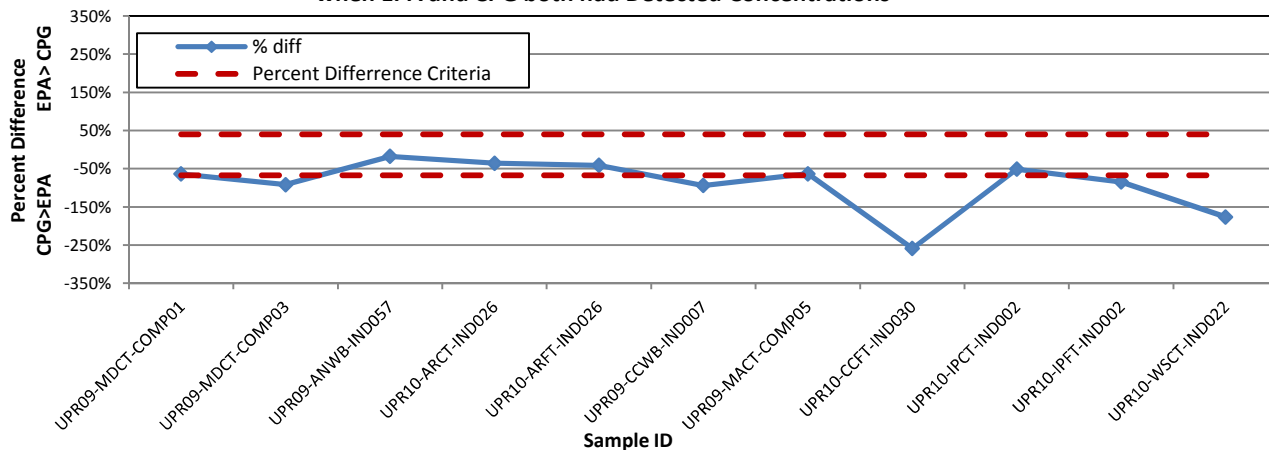


Figure 29a: Line Plot of Benzo[a]anthracene Concentrations

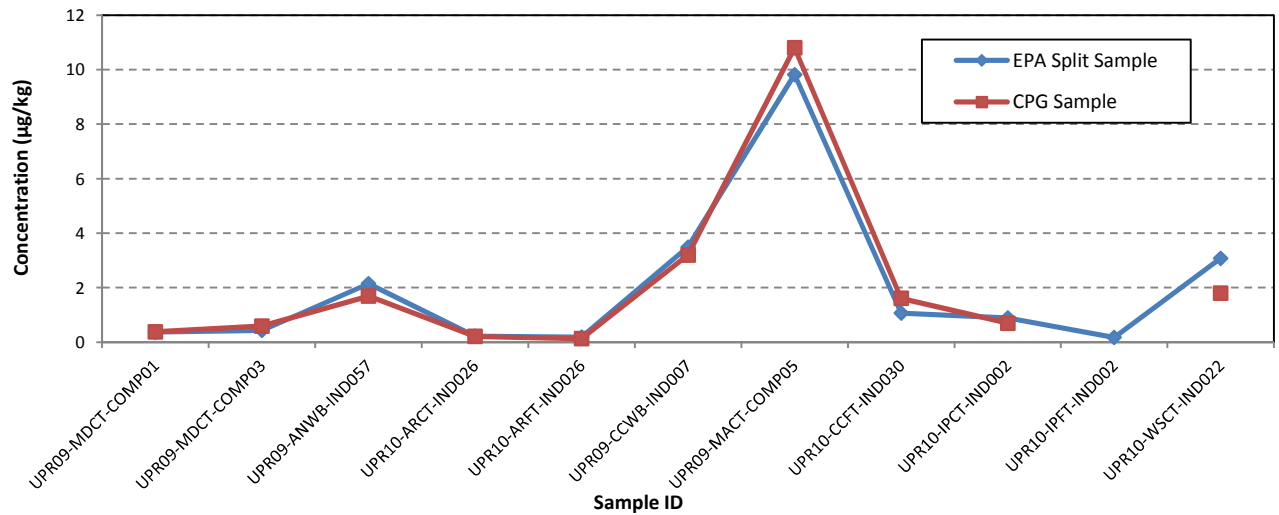


Figure 29b: Bivariate Plot of Benz[a]anthracene Concentrations

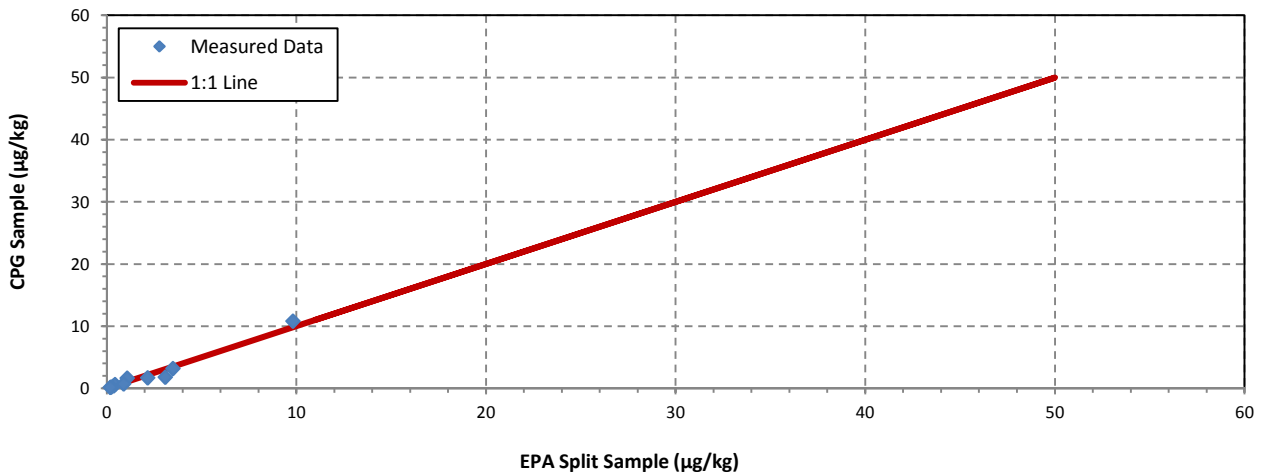


Figure 29c: Line Plot of Benz[a]anthracene Percent Differences when EPA and CPG both had Detected Concentrations

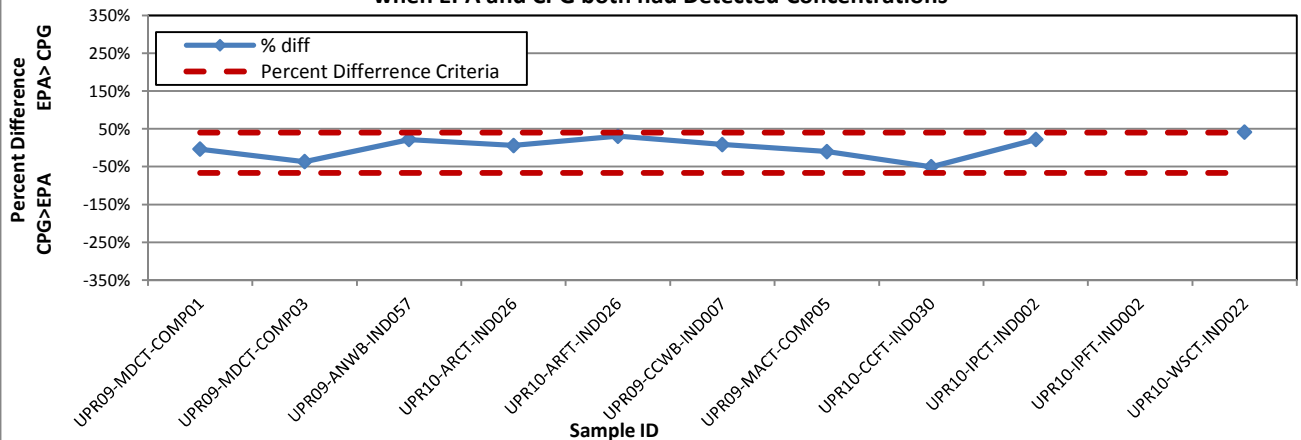


Figure 30a: Line Plot of Benzo[a]pyrene Concentrations

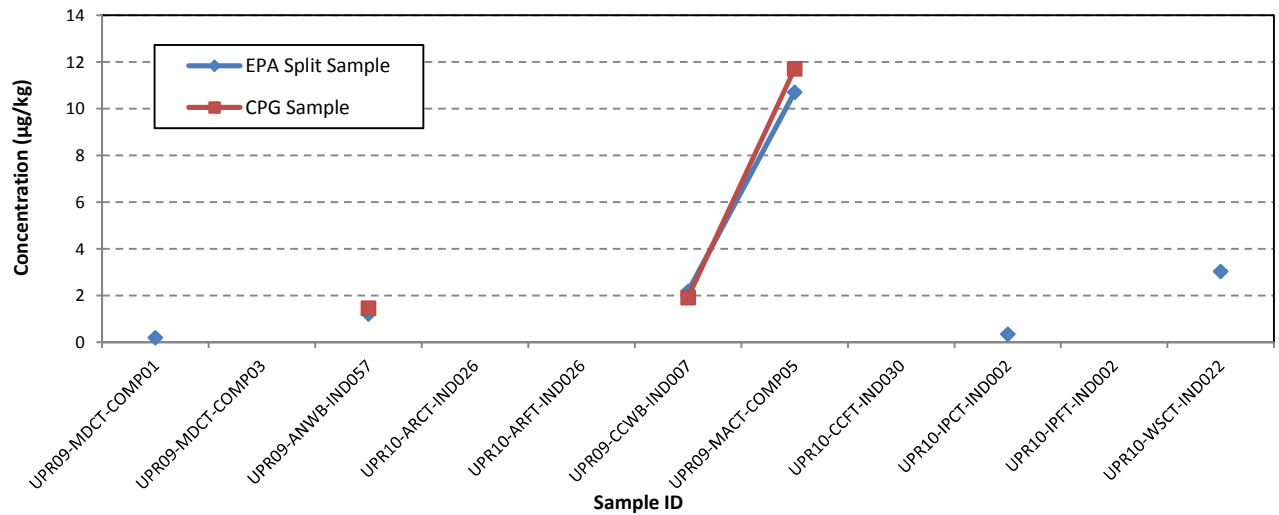


Figure 30b: Bivariate Plot of Benzo[a]pyrene Concentrations

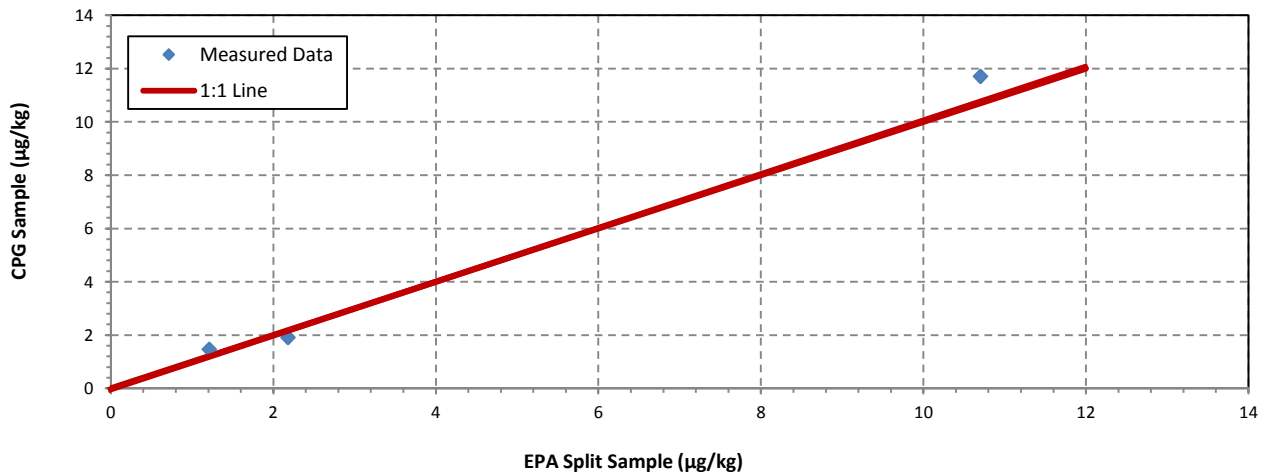
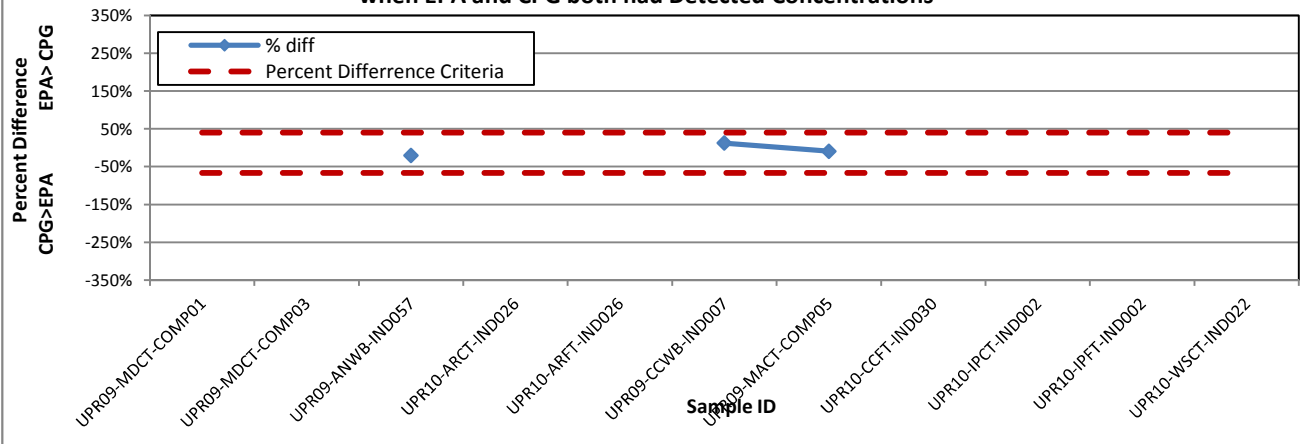


Figure 30c: Line Plot of Benzo[a]pyrene Percent Differences when EPA and CPG both had Detected Concentrations



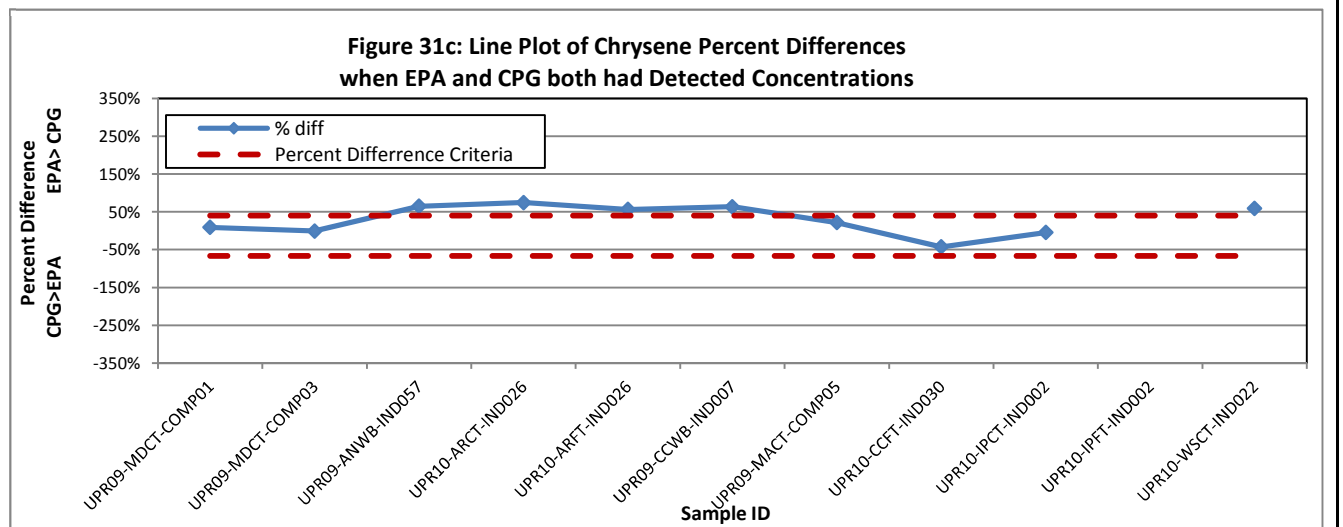
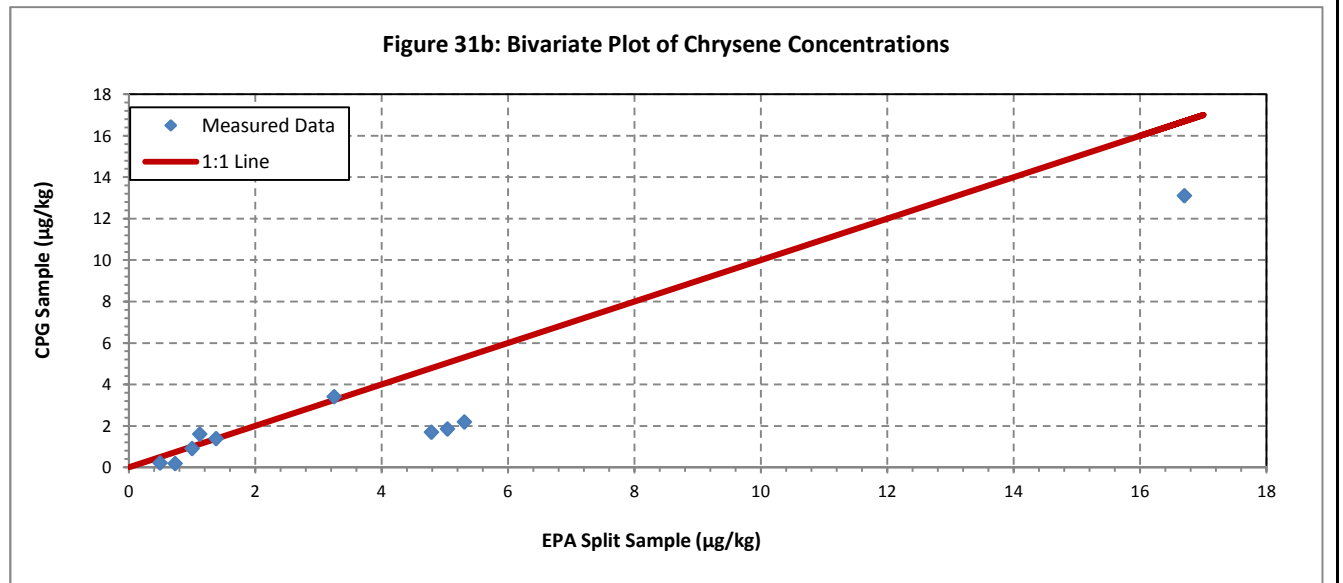
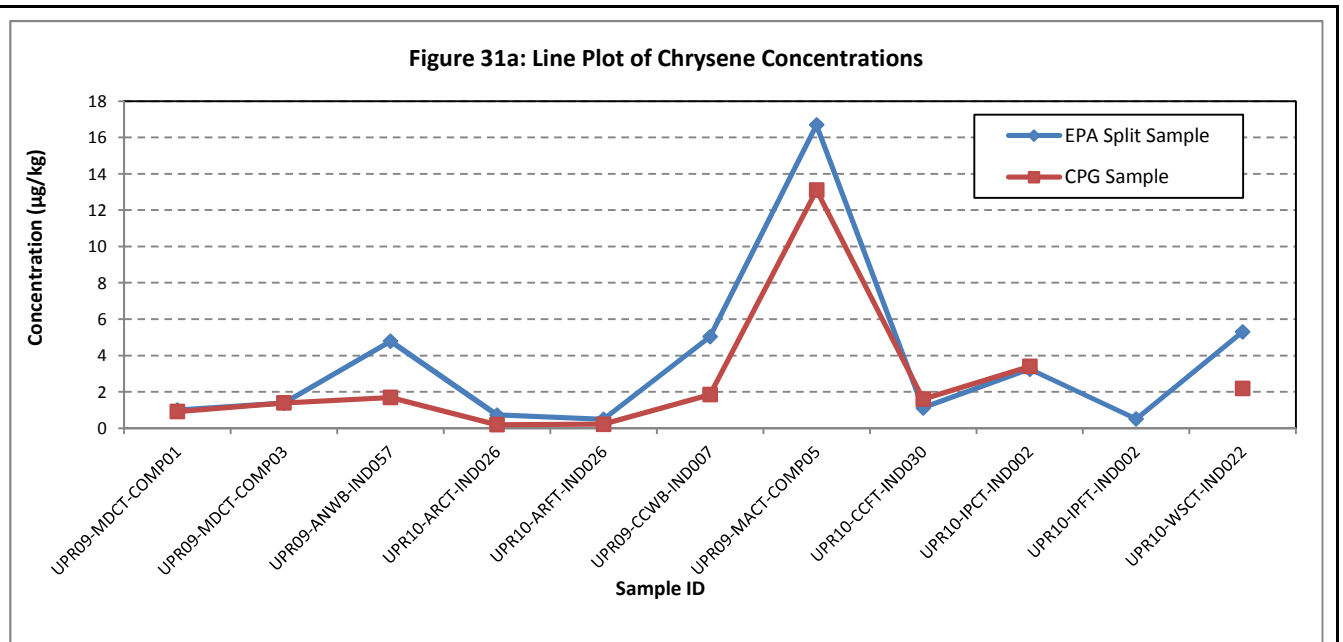


Figure 33a: Line Plot of Indeno[1,2,3-cd]pyrene Concentrations

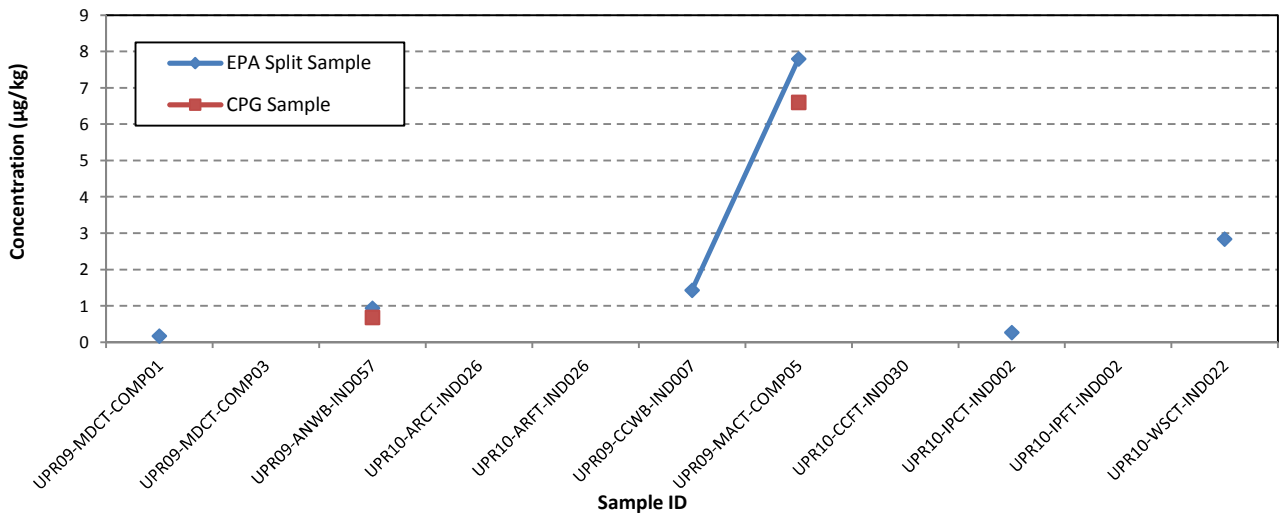


Figure 33b: Bivariate Plot of Indeno[1,2,3-cd]pyrene Concentrations

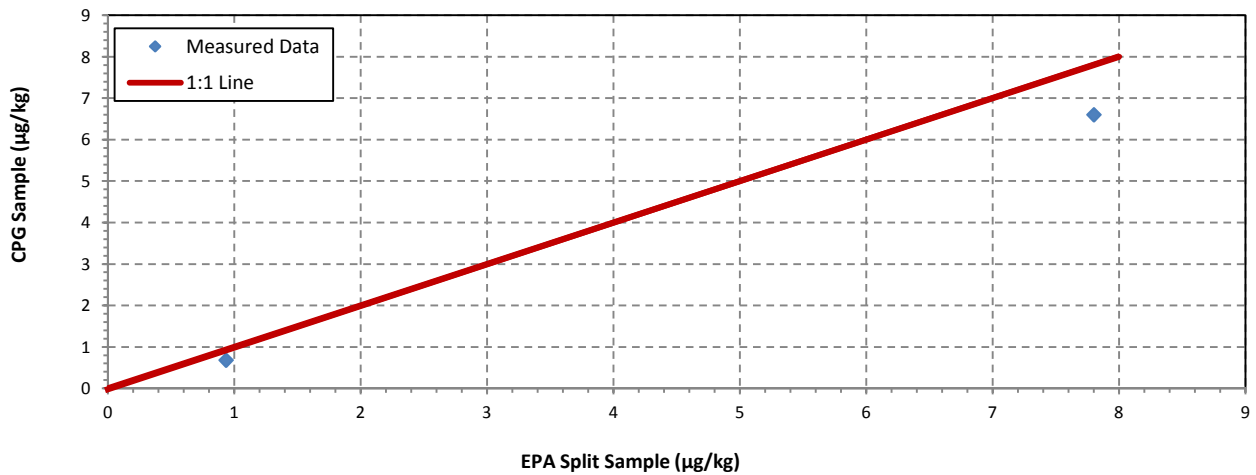


Figure 33c: Line Plot of Indeno[1,2,3-cd]pyrene Percent Differences when EPA and CPG both had Detected Concentrations

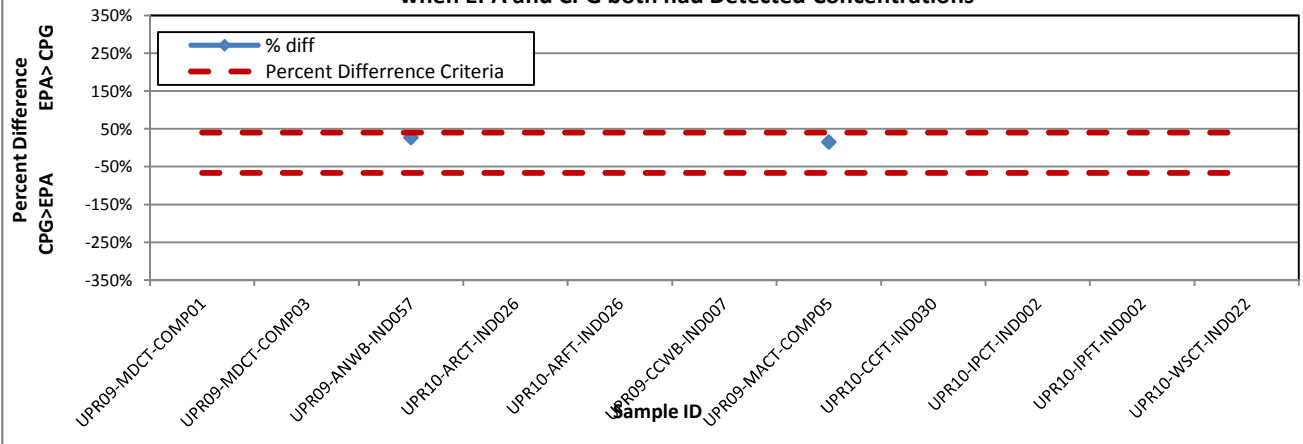


Figure 32a: Line Plot of Fluoranthene Concentrations

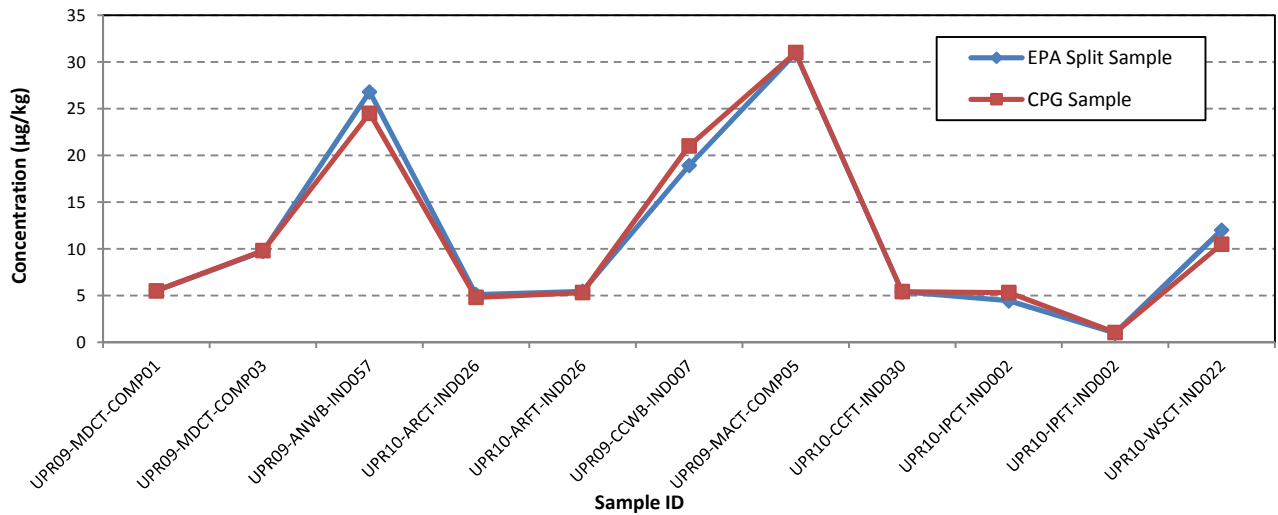


Figure 32b: Bivariate Plot of Fluoranthene Concentrations

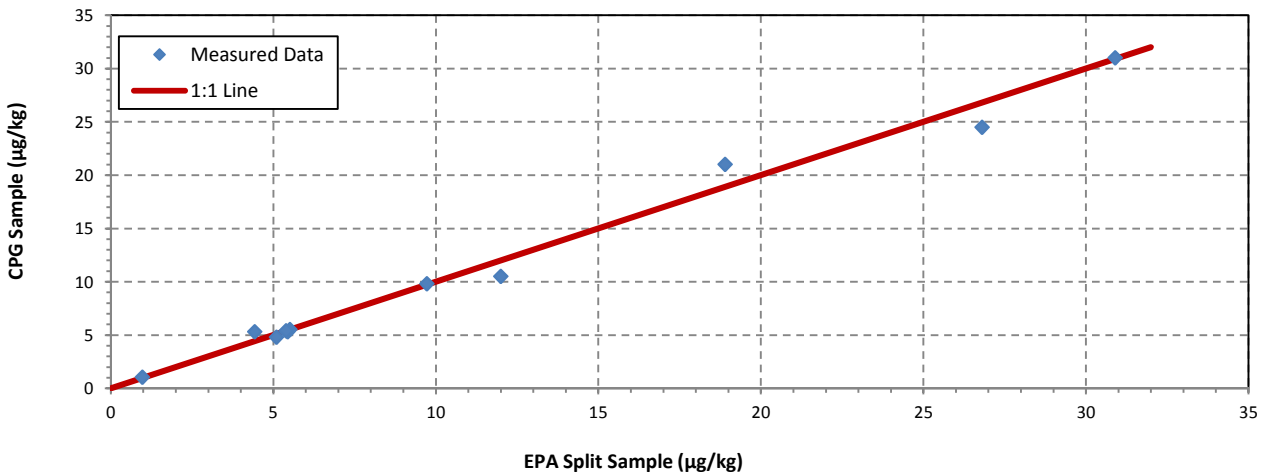


Figure 32c: Line Plot of Fluoranthene Percent Differences when EPA and CPG both had Detected Concentrations

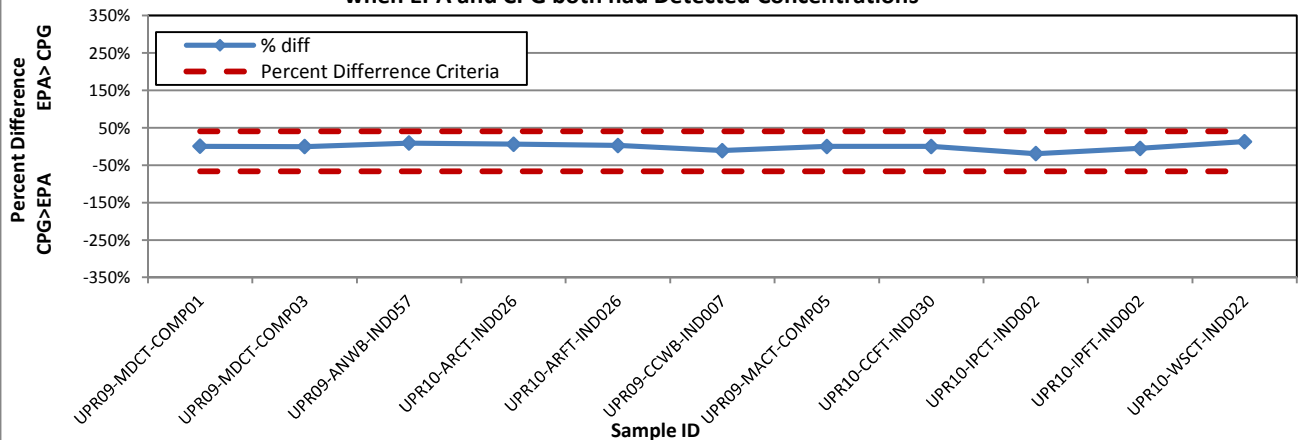


Figure 34a: Line Plot of Naphthalene Concentrations

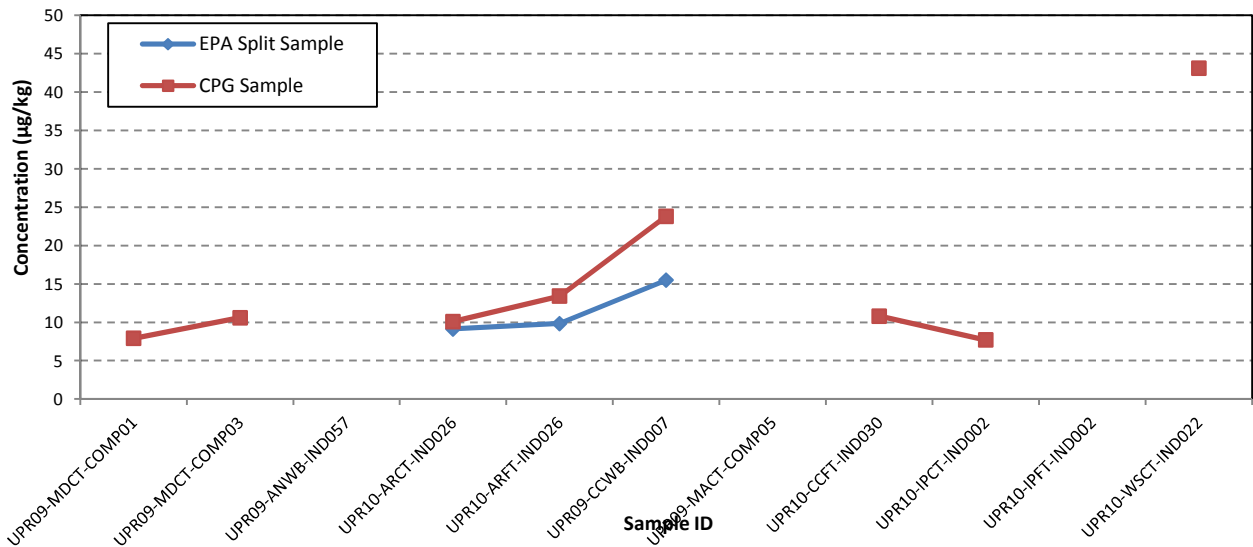


Figure 34b: Bivariate Plot of Naphthalene Concentrations

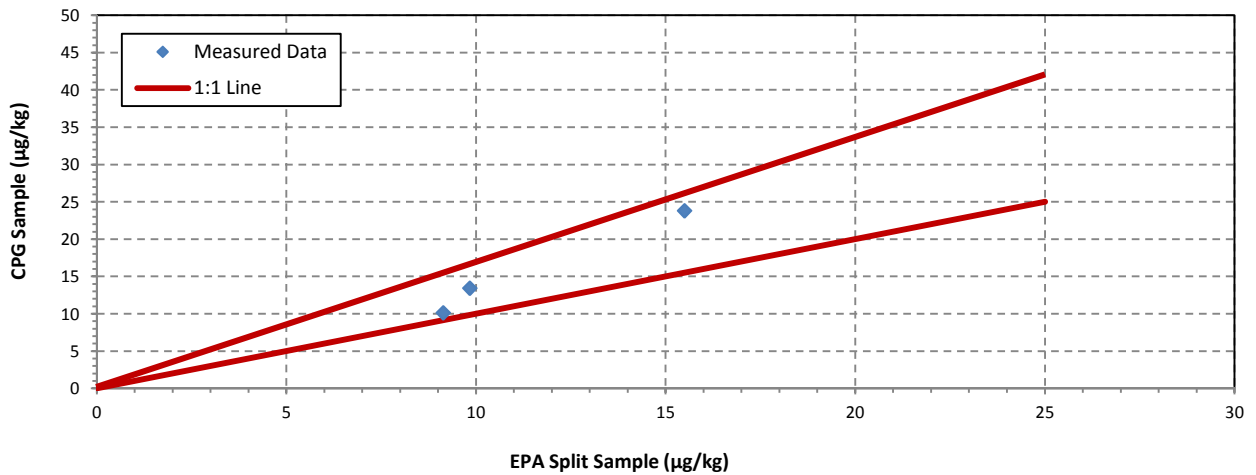


Figure 34c: Line Plot of Naphthalene Percent Differences when EPA and CPG both had Detected Concentrations

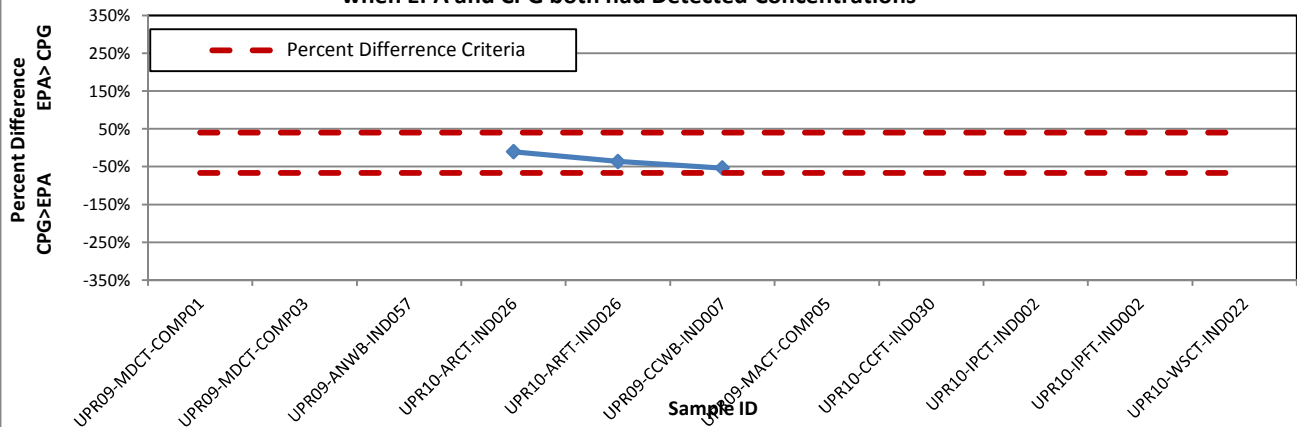


Figure 35a: Line Plot of Phenanthrene Concentrations

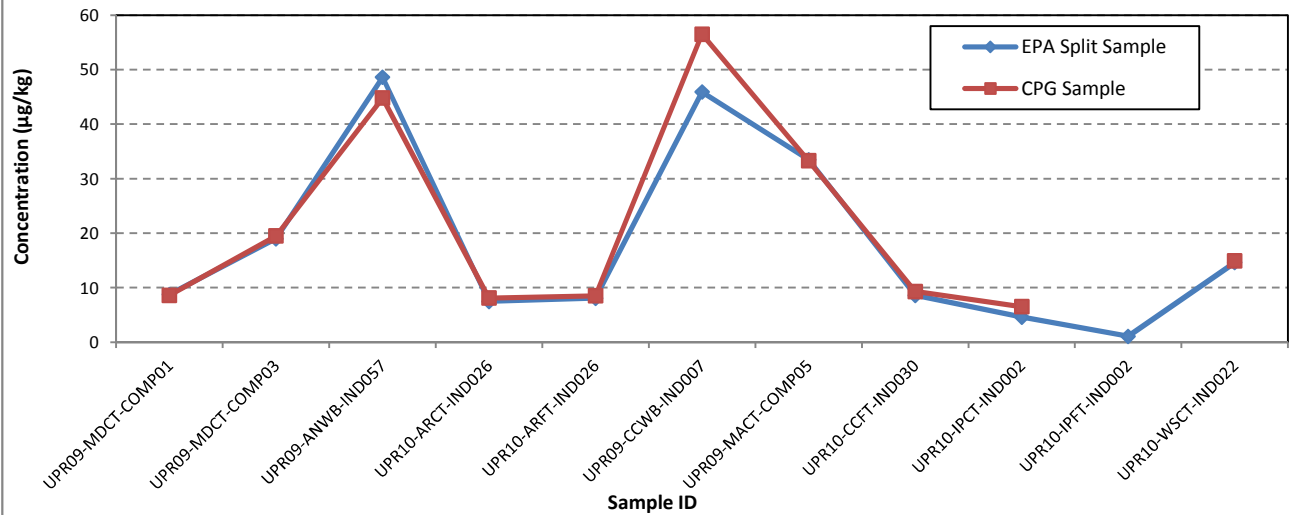


Figure 35b: Bivariate Plot of Phenanthrene Concentrations

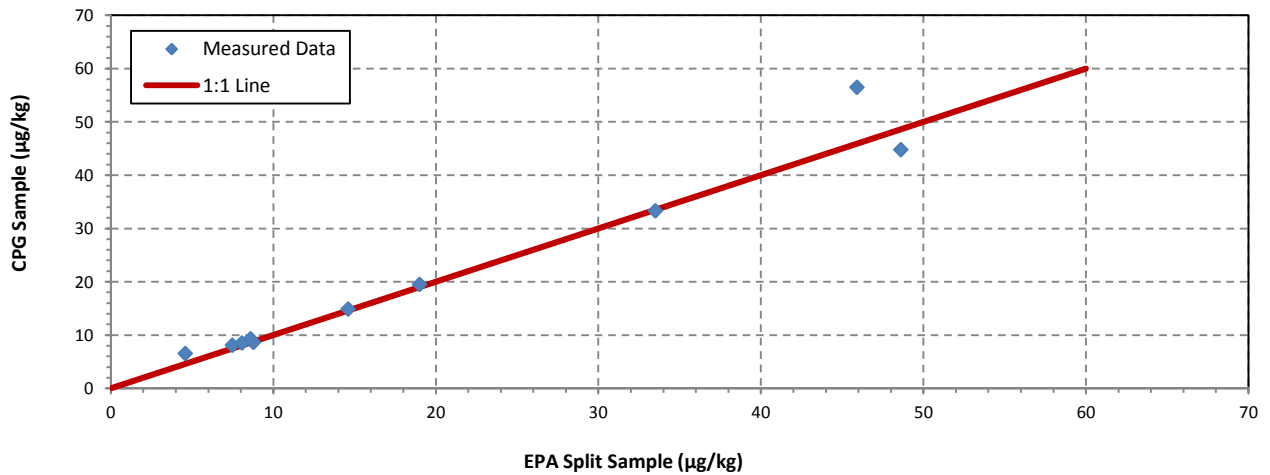
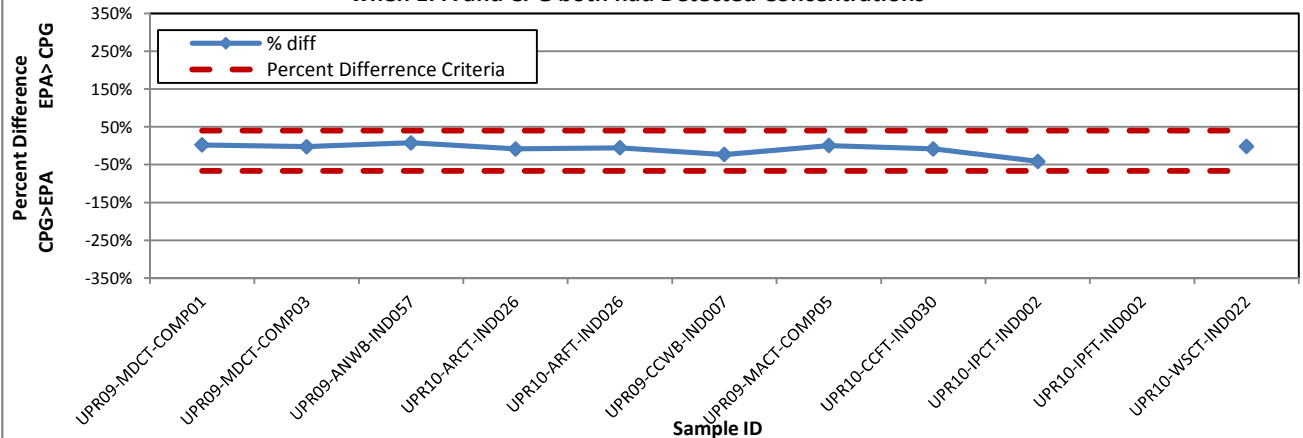


Figure 35c: Line Plot of Phenanthrene Percent Differences when EPA and CPG both had Detected Concentrations



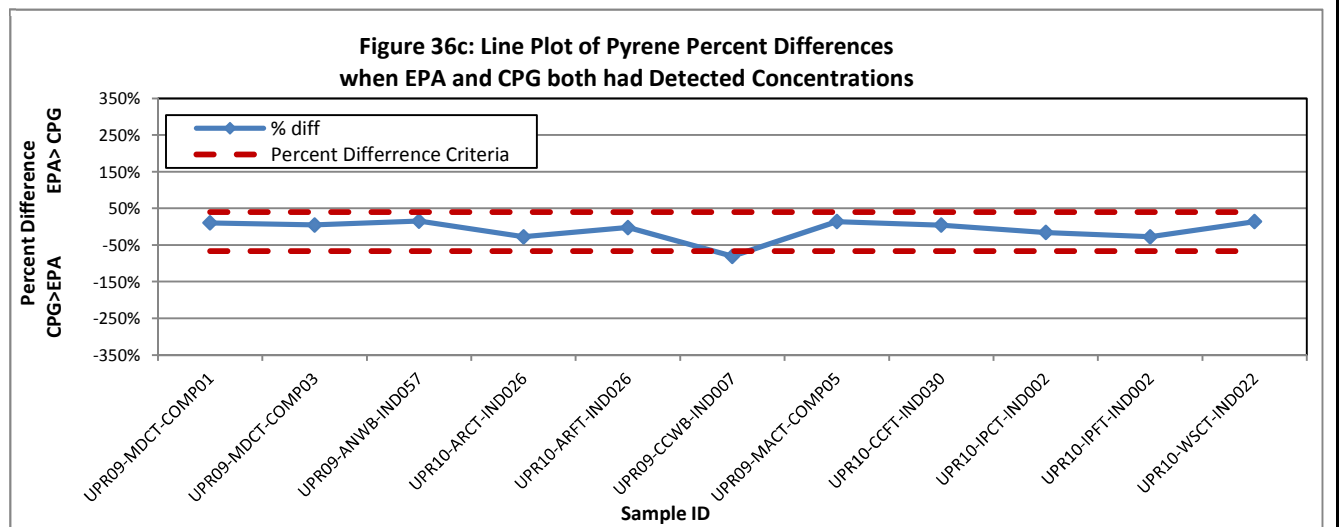
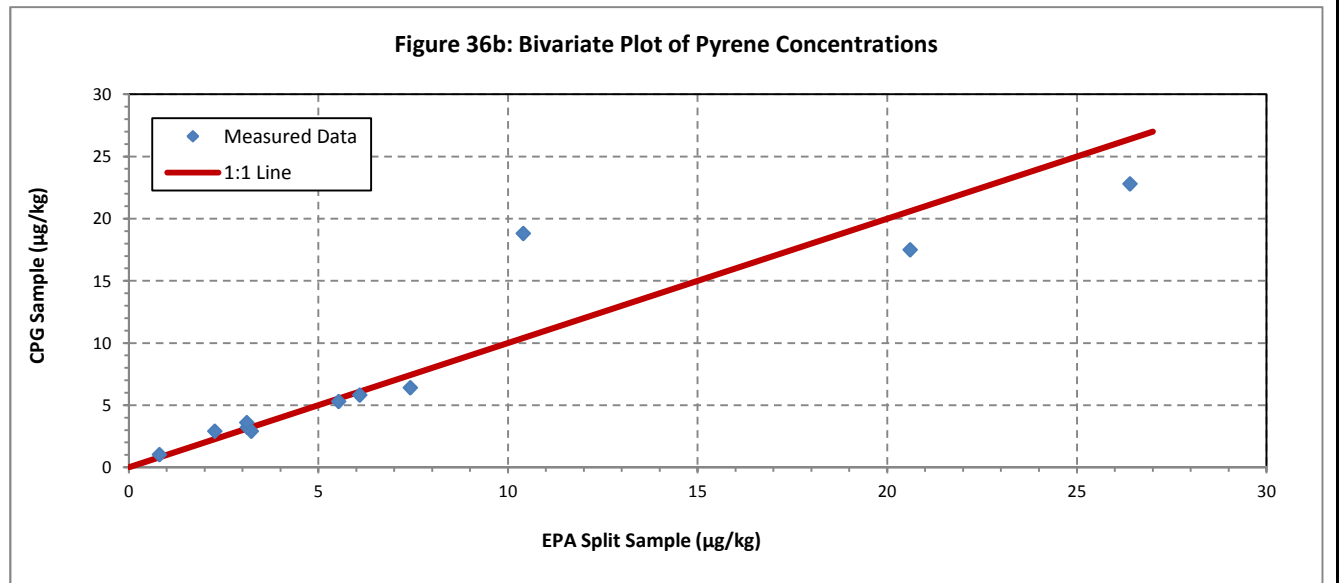
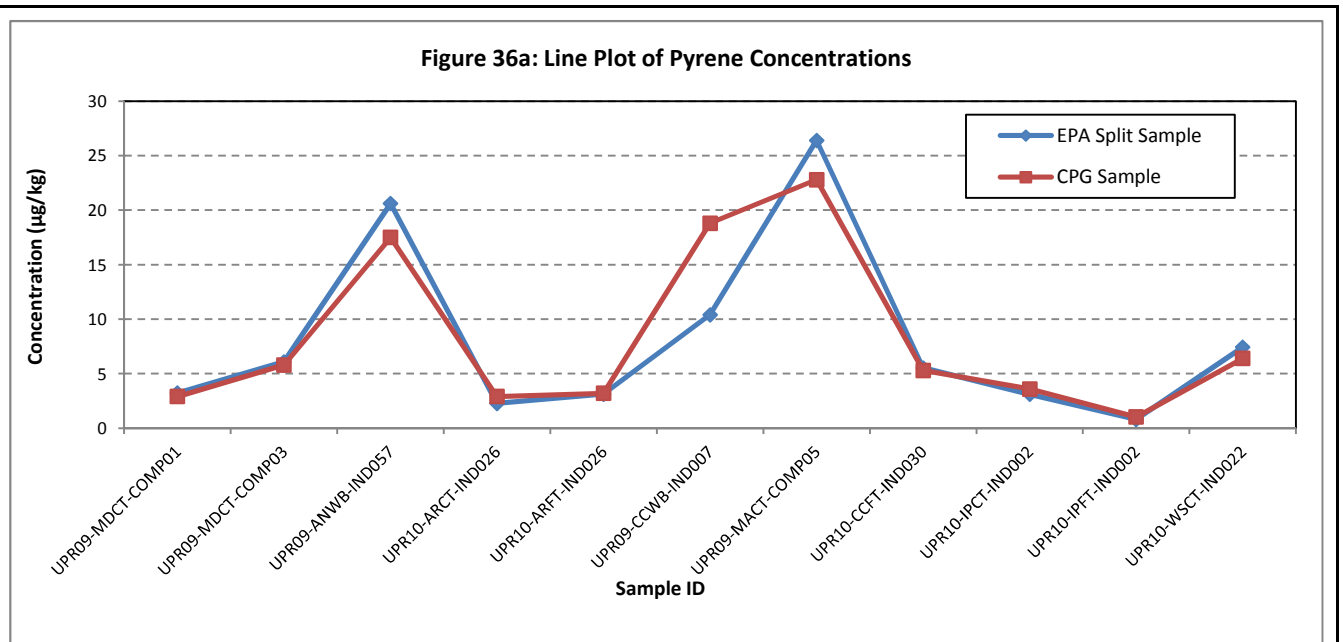


Figure 37a: Line Plot of Total Extractable Lipids Concentrations

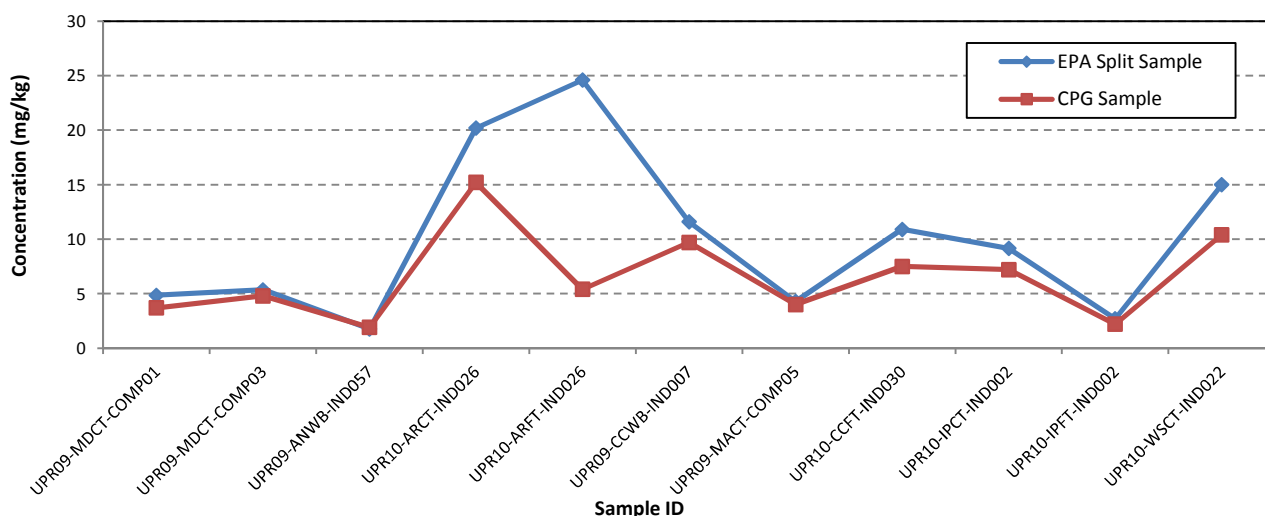


Figure 37b: Bivariate Plot of Total Extractable Lipids Concentrations

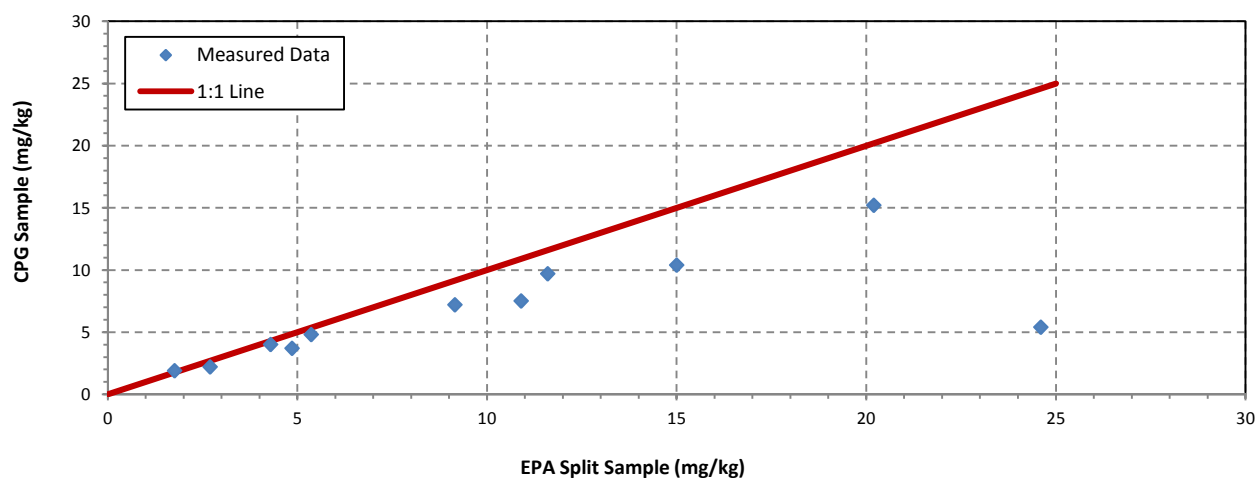
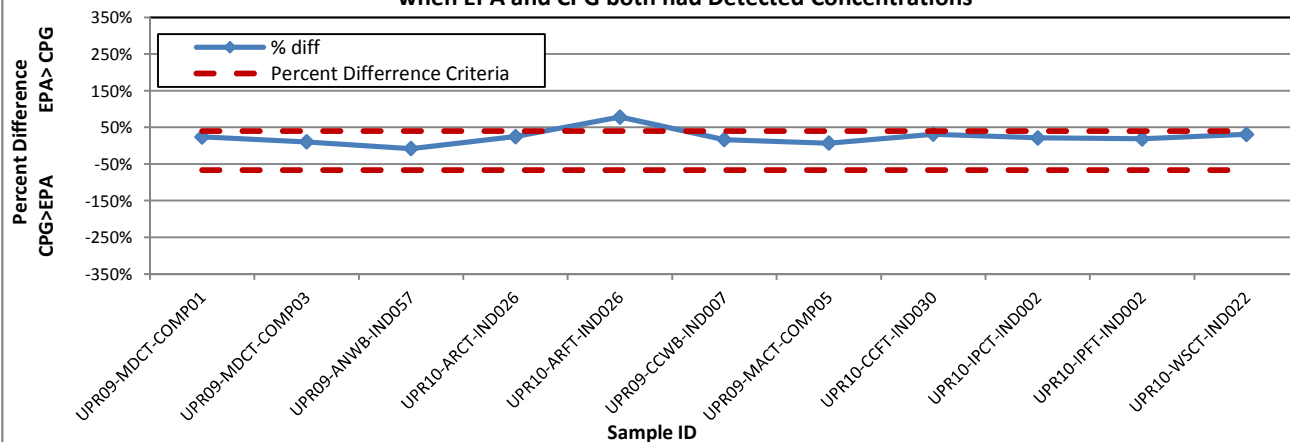


Figure 37c: Line Plot of Total Extractable Lipids Percent Differences when EPA and CPG both had Detected Concentrations



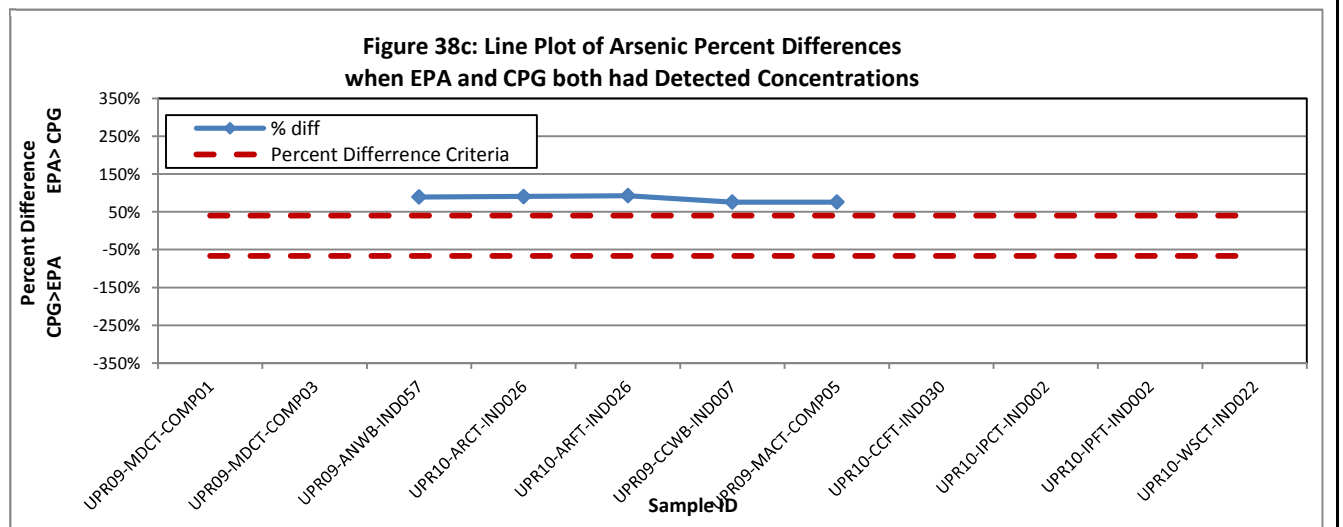
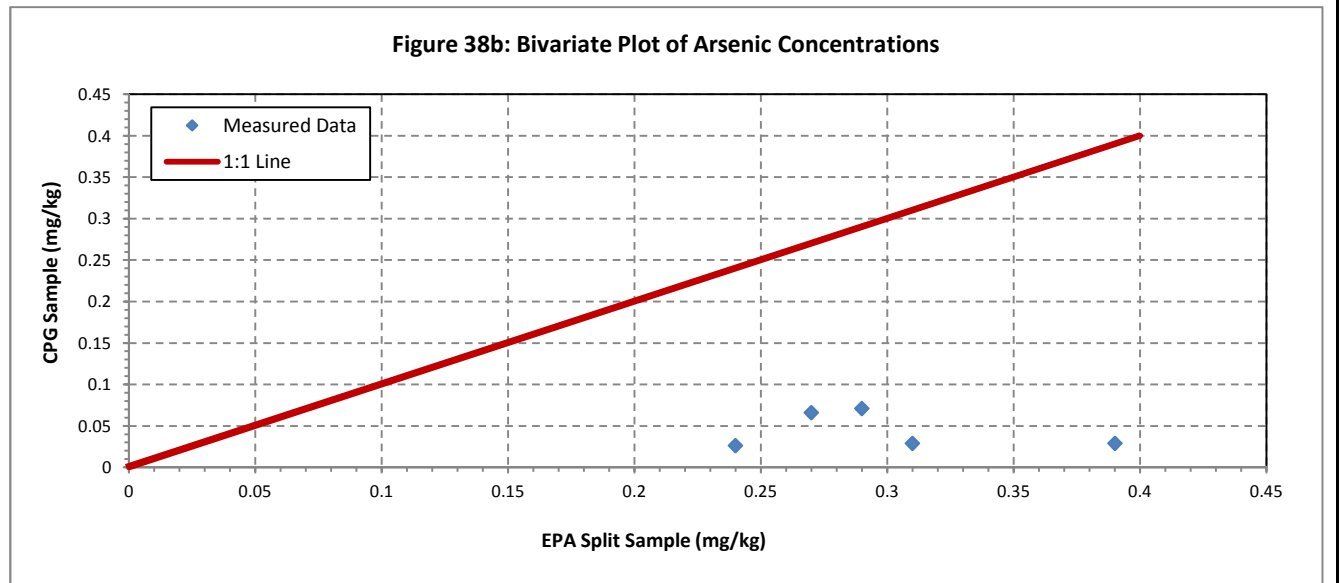
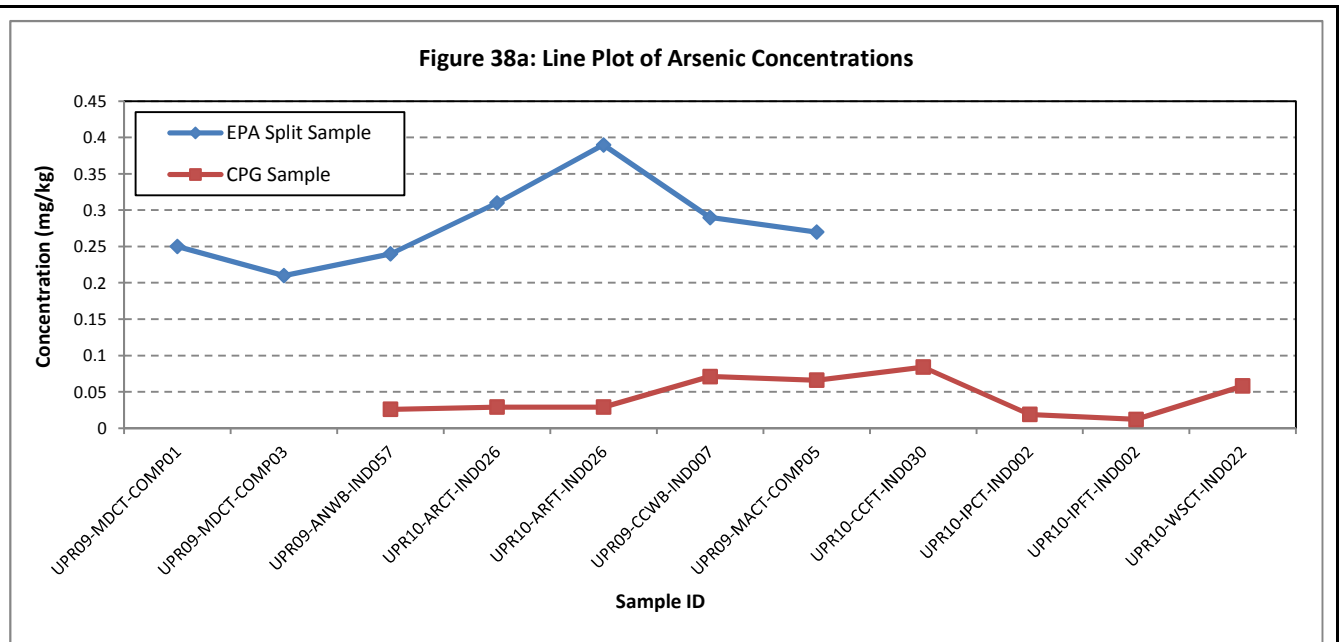


Figure 39a: Line Plot of Barium Concentrations

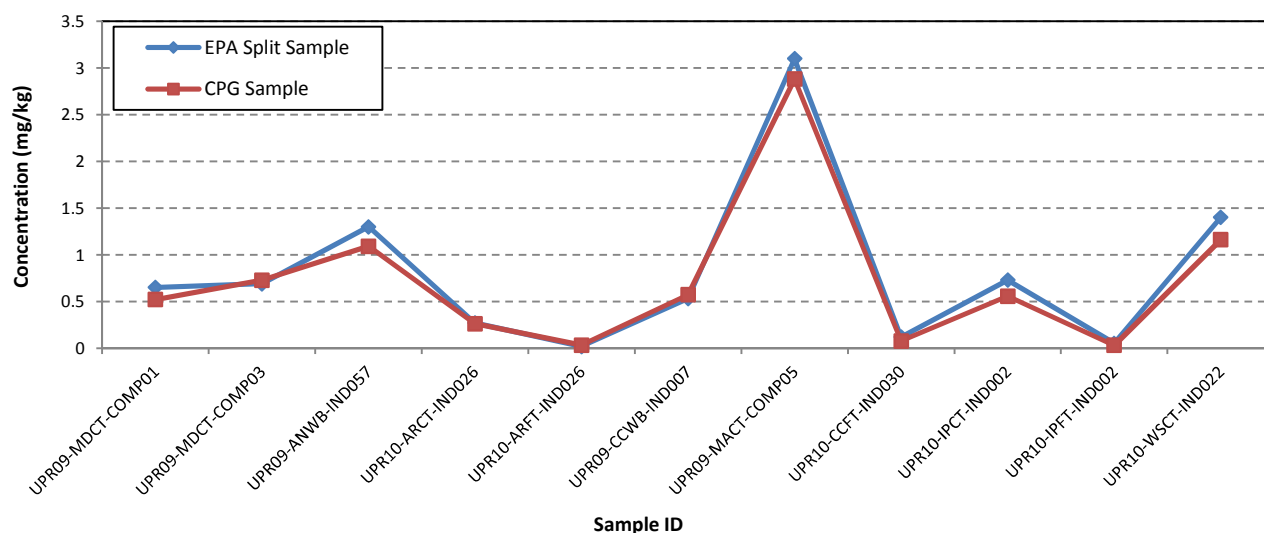


Figure 39b: Bivariate Plot of Barium Concentrations

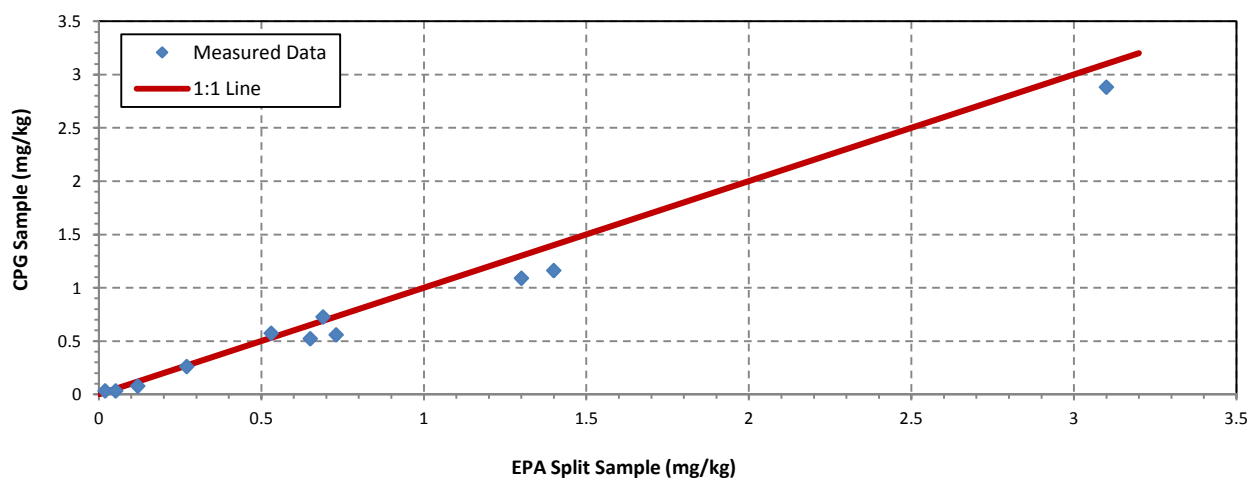
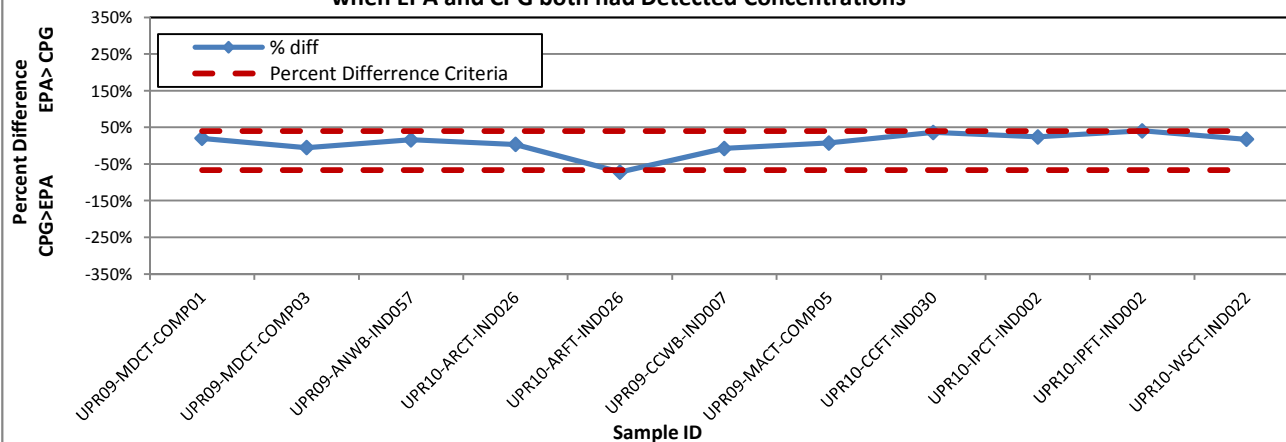
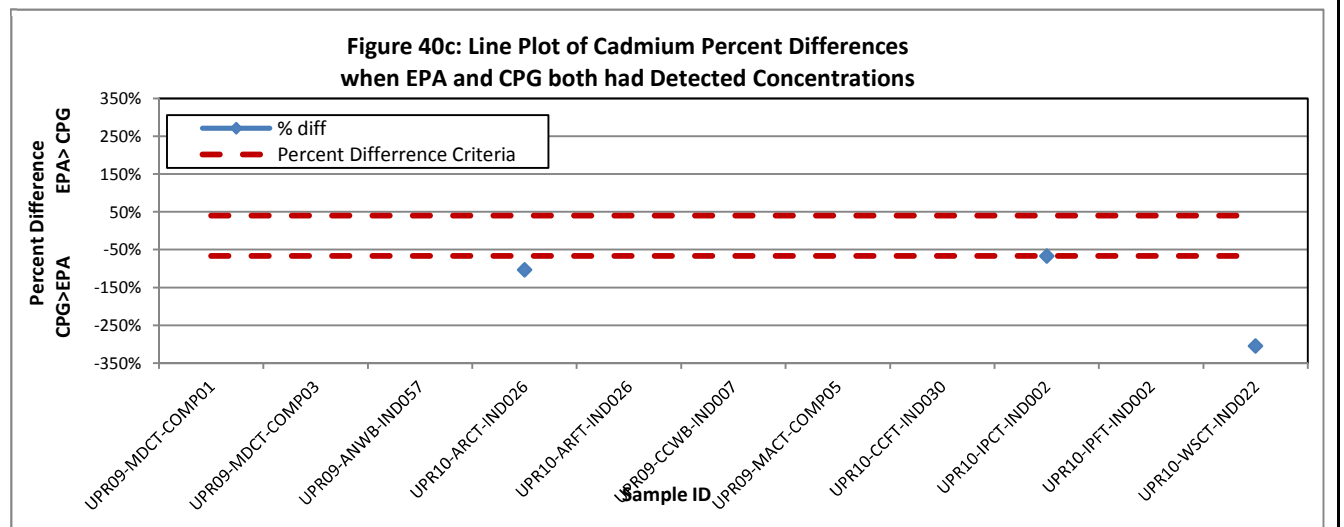
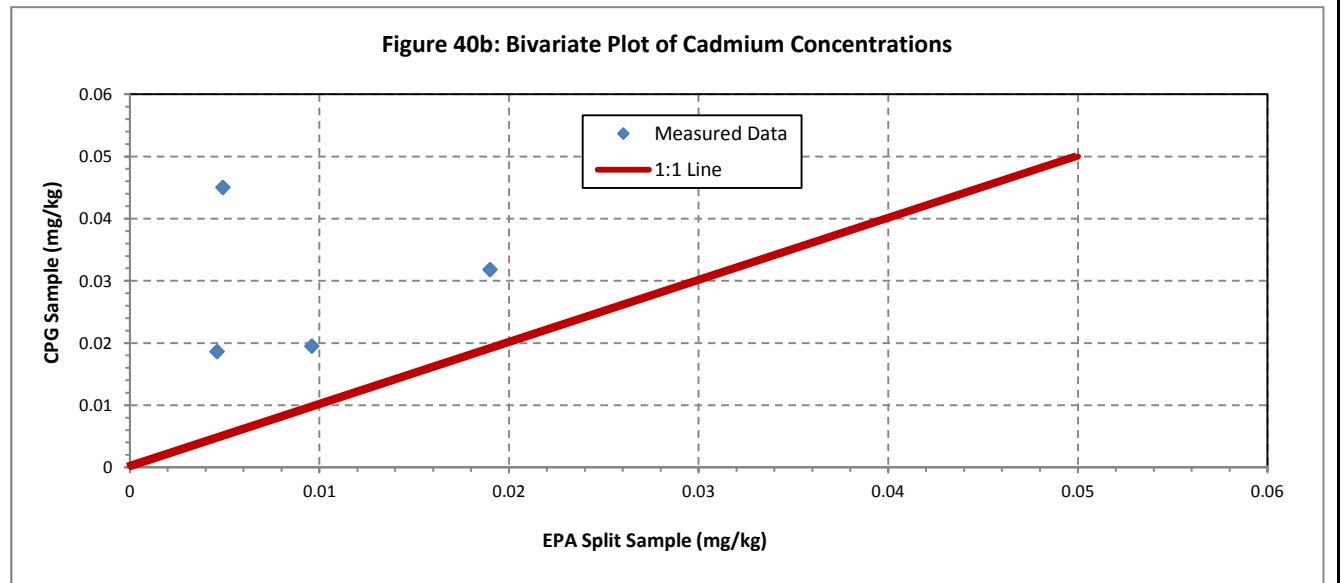
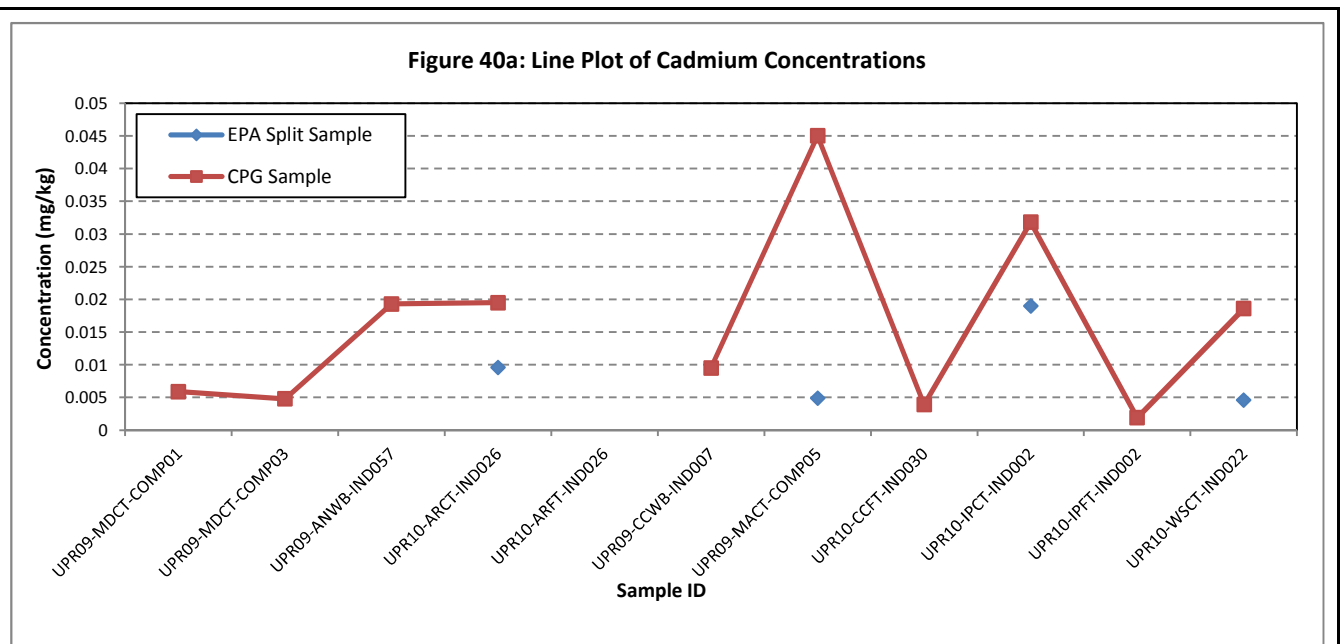


Figure 39c: Line Plot of Barium Percent Differences when EPA and CPG both had Detected Concentrations





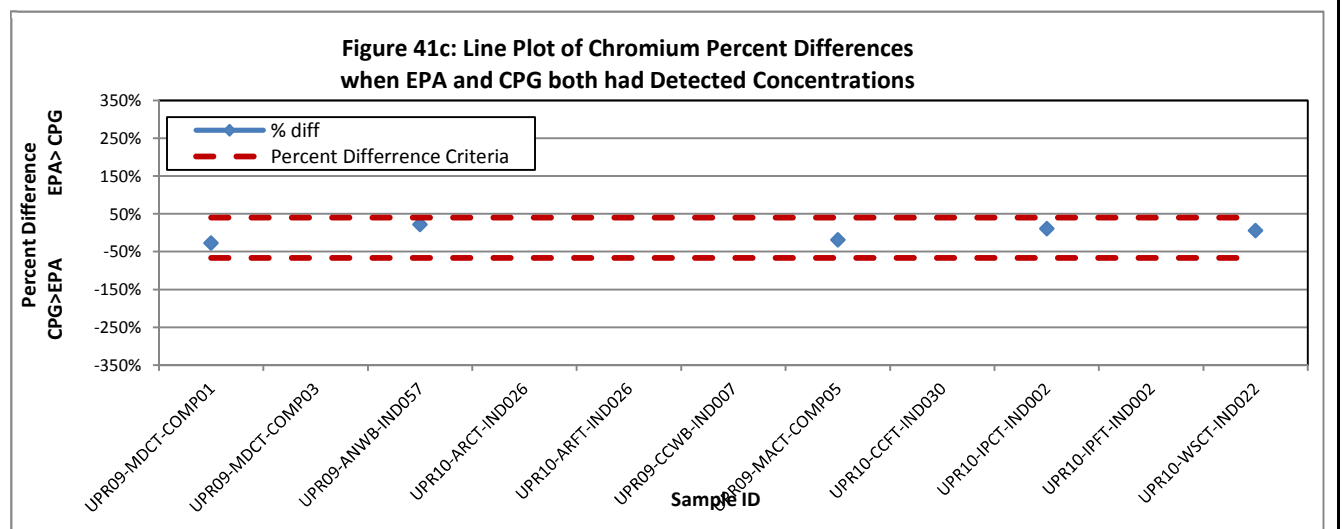
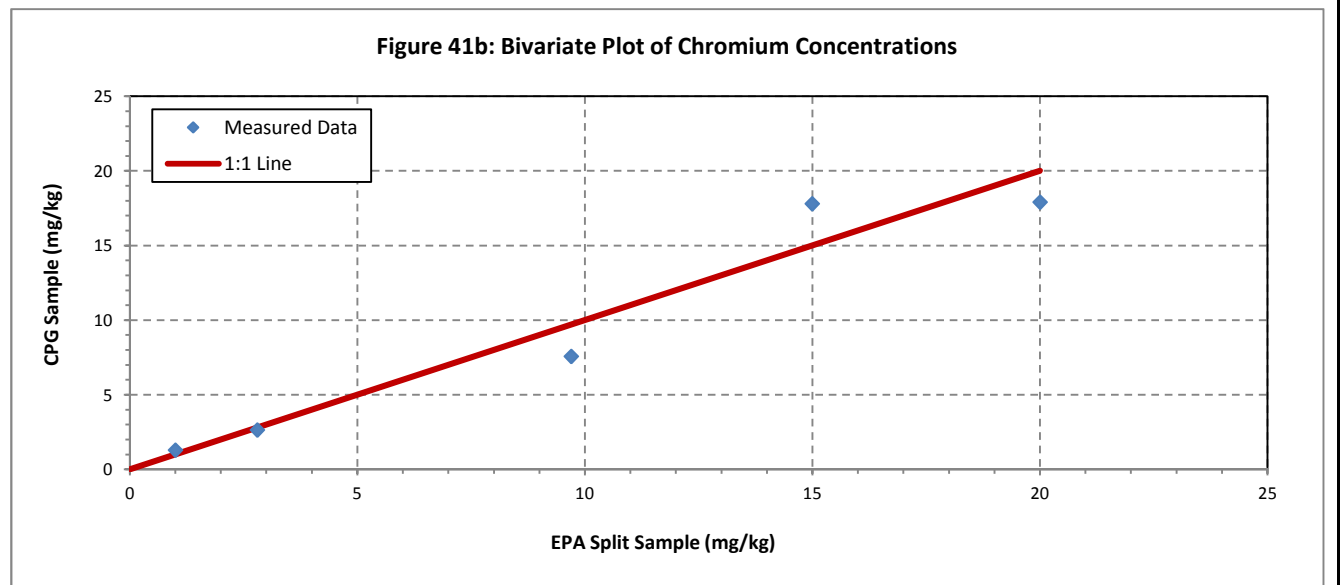
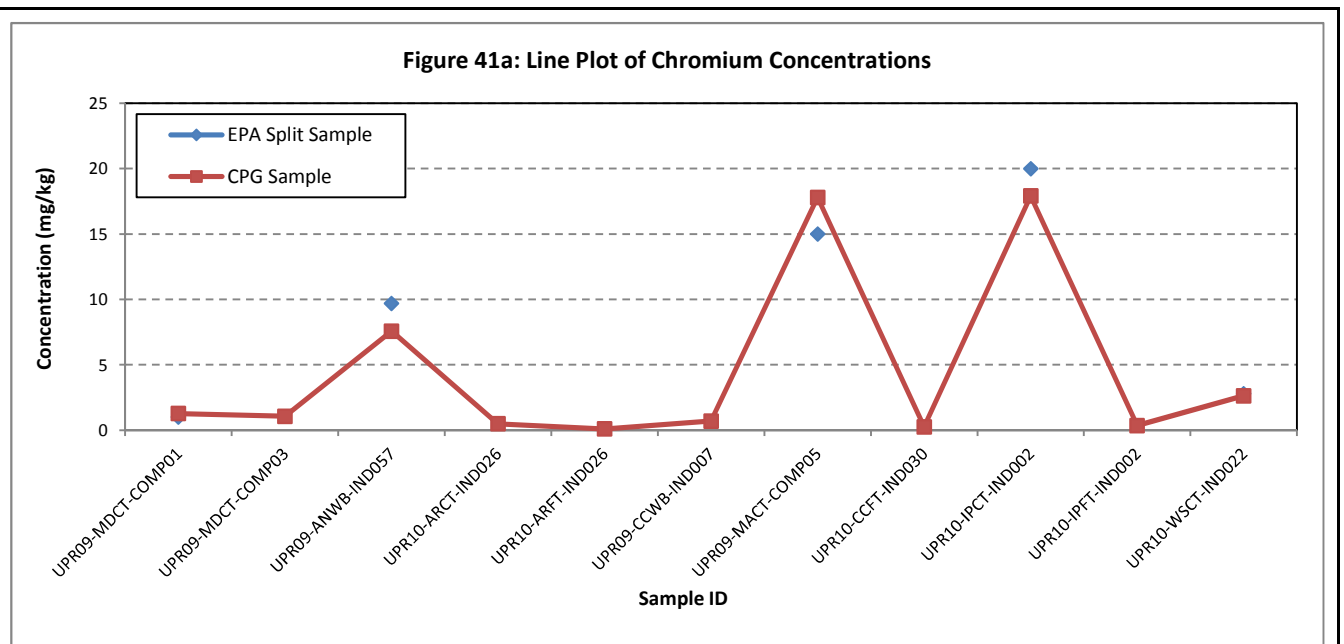


Figure 42a: Line Plot of Cobalt Concentrations

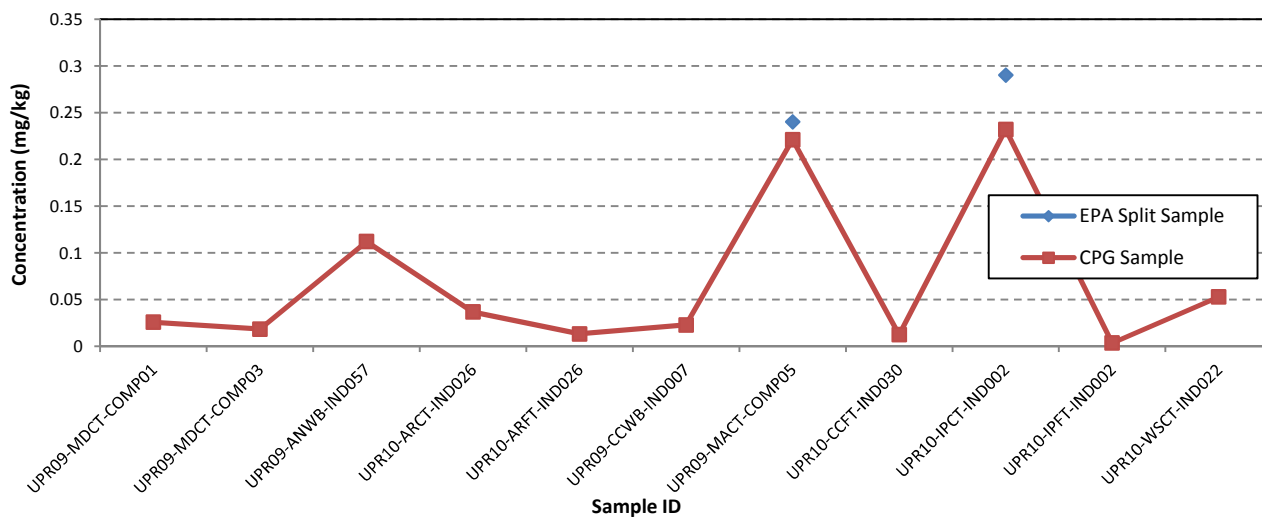


Figure 42b: Bivariate Plot of Cobalt Concentrations

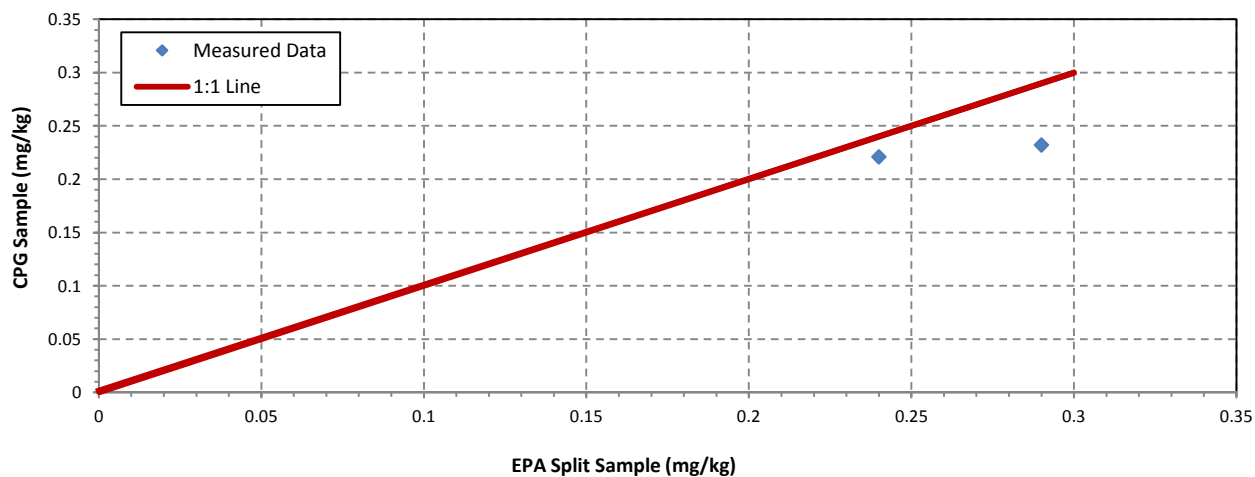
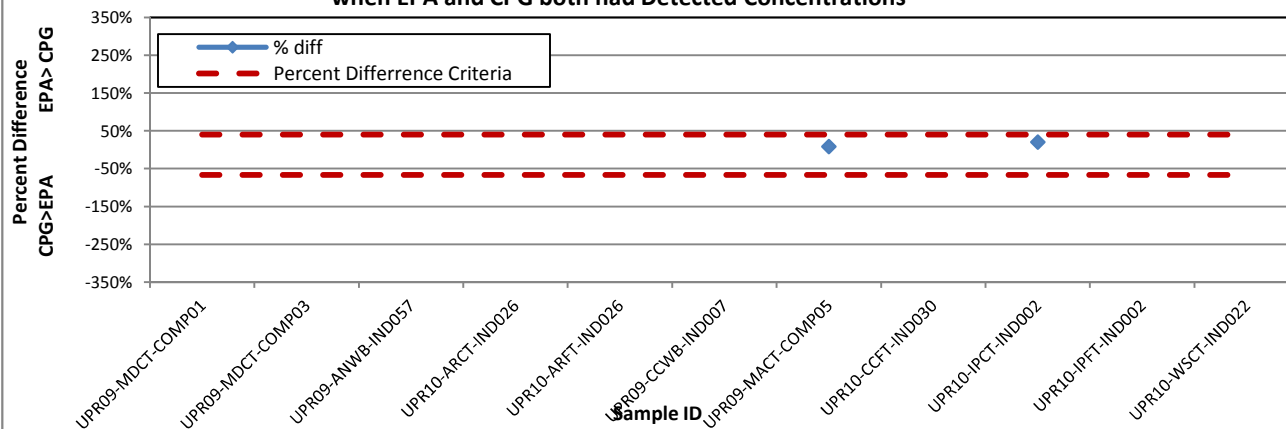


Figure 42c: Line Plot of Cobalt Percent Differences when EPA and CPG both had Detected Concentrations



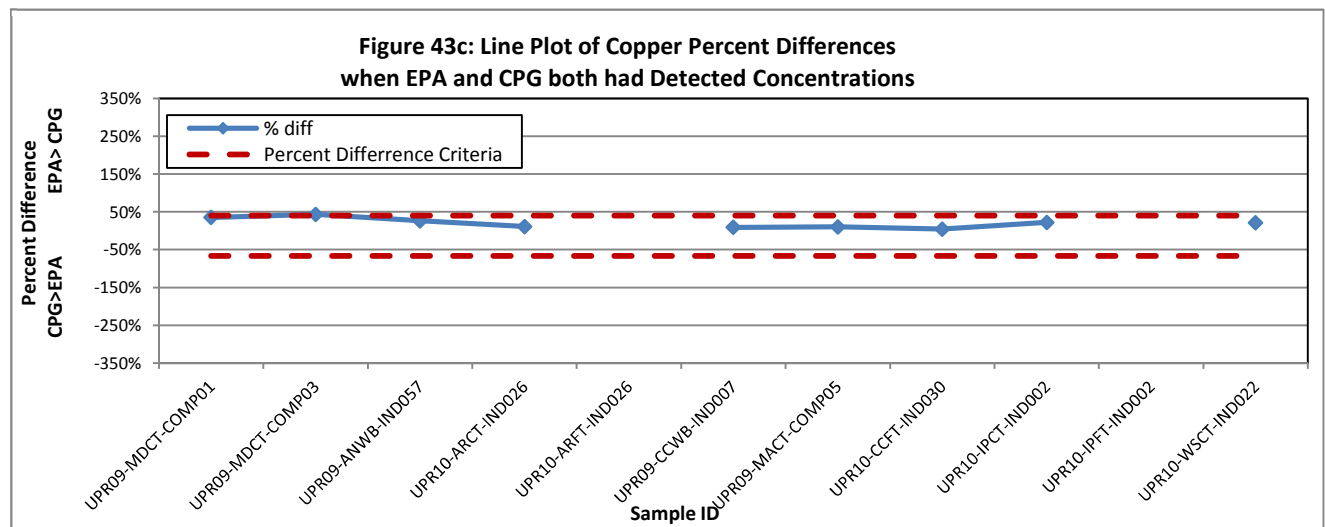
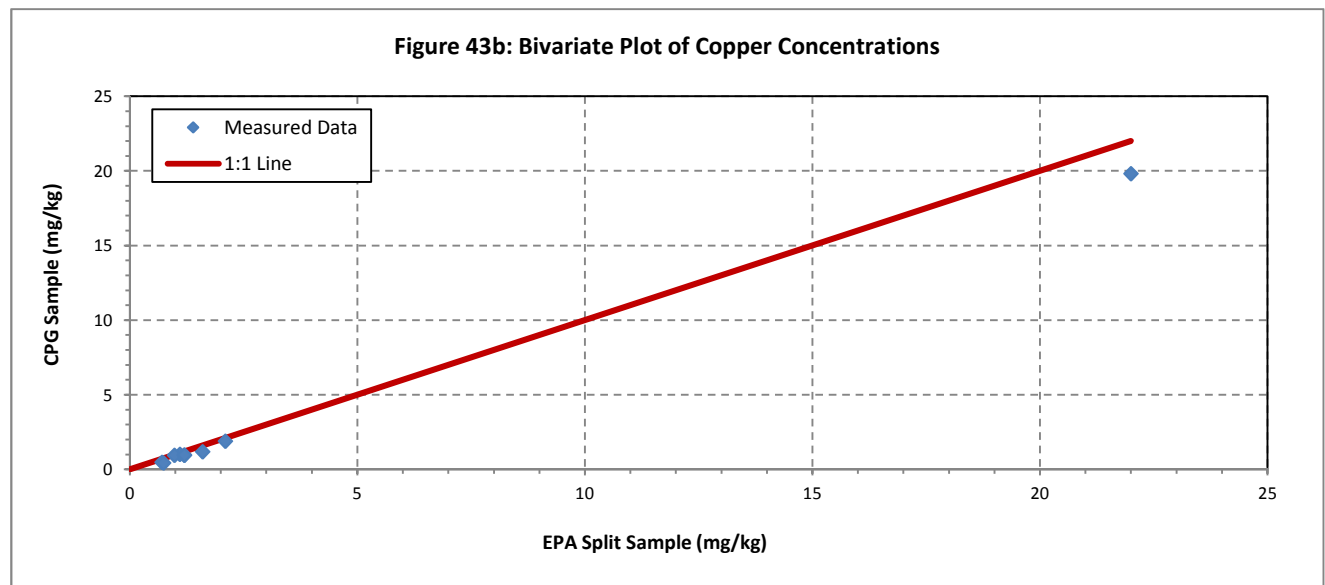
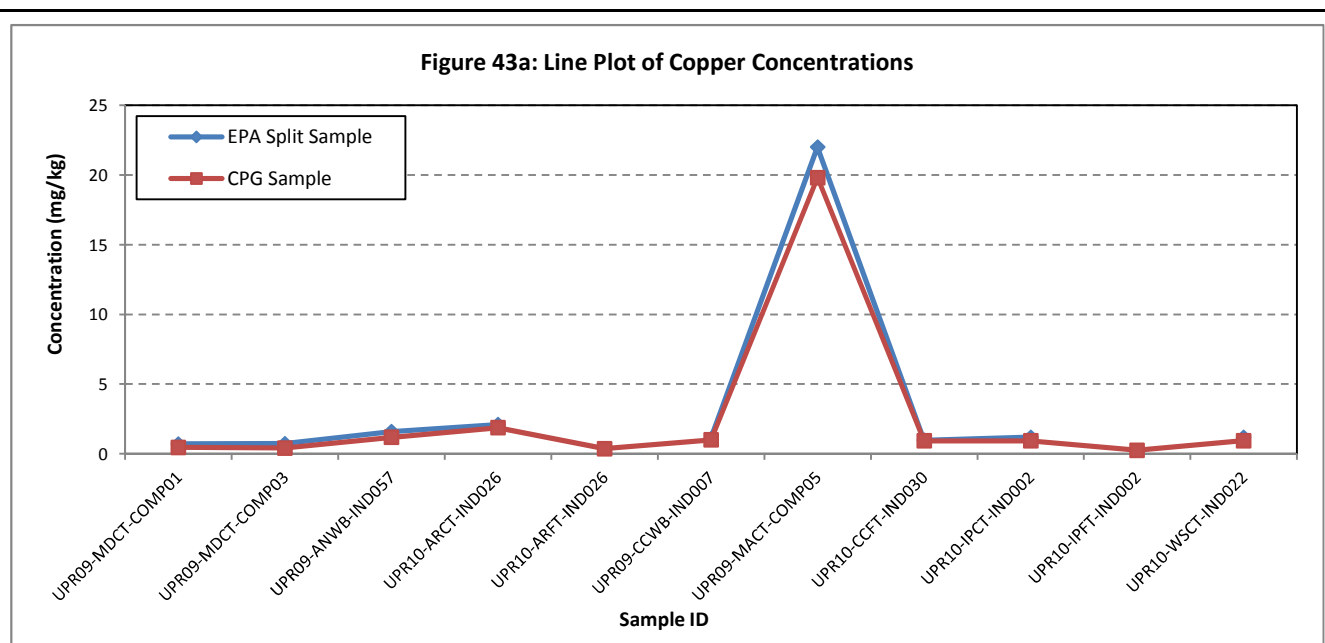


Figure 44a: Line Plot of Iron Concentrations

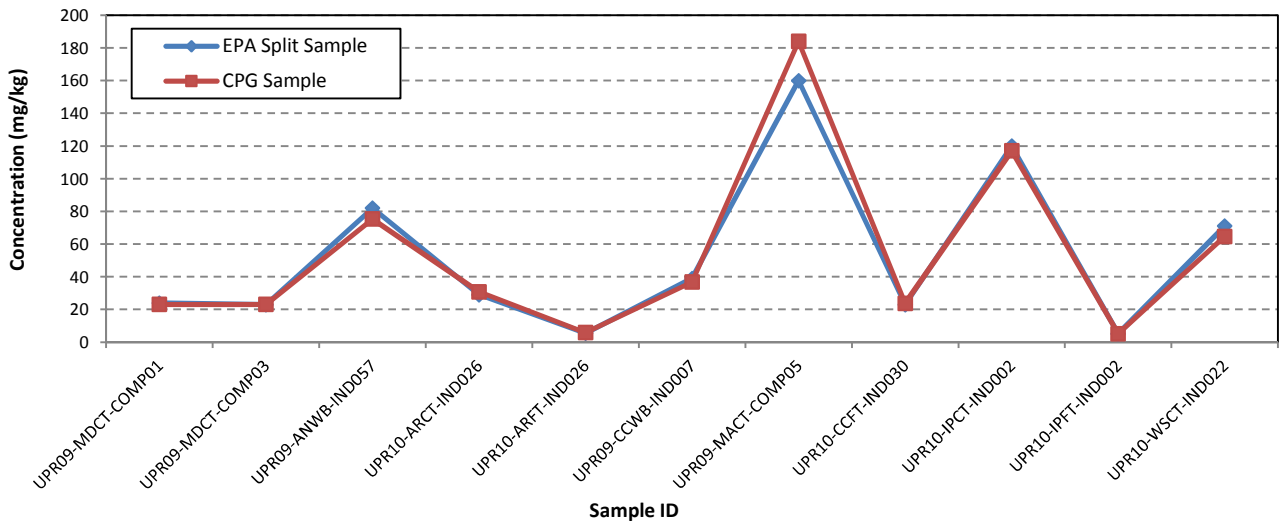


Figure 44b: Bivariate Plot of Iron Concentrations

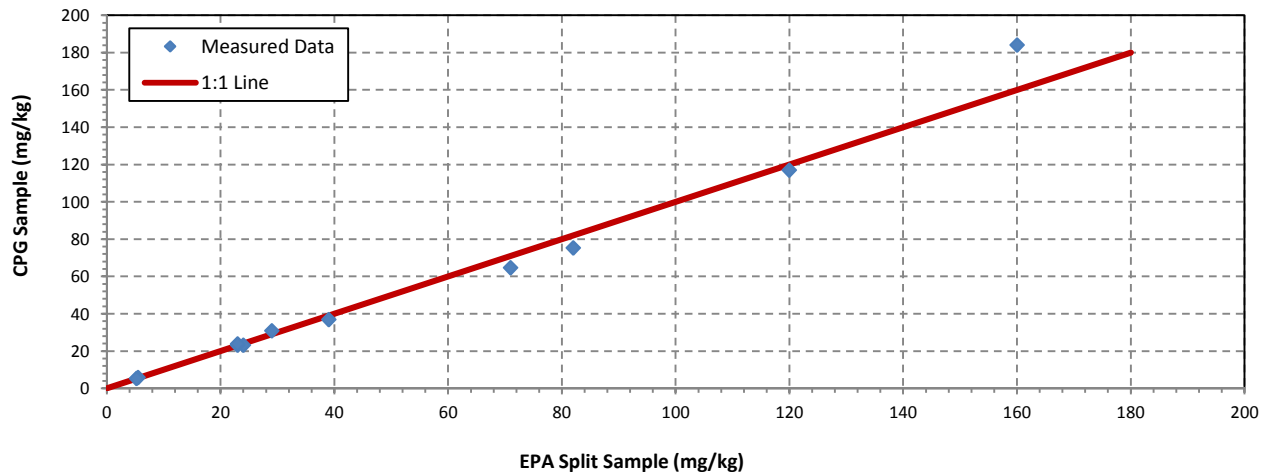
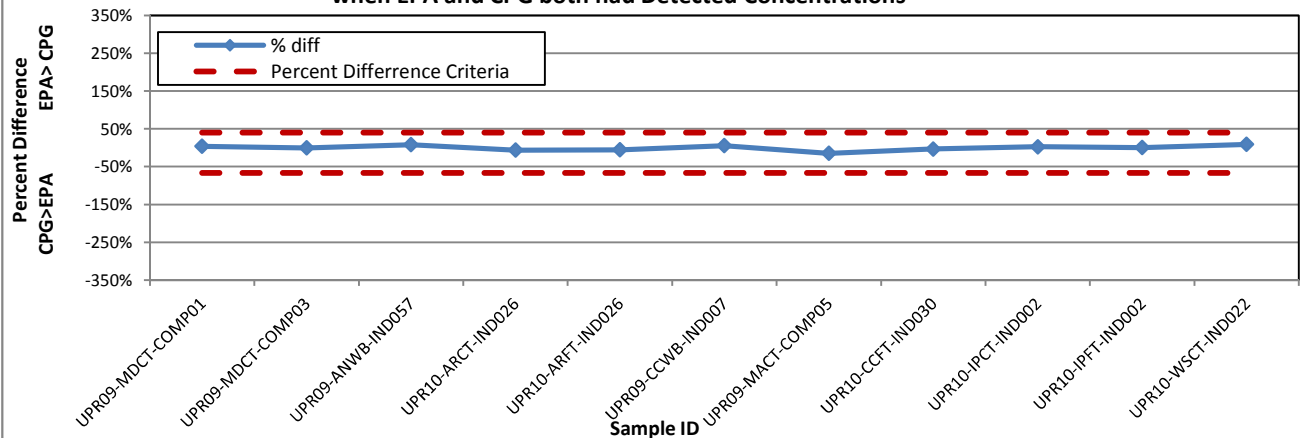


Figure 44c: Line Plot of Iron Percent Differences when EPA and CPG both had Detected Concentrations



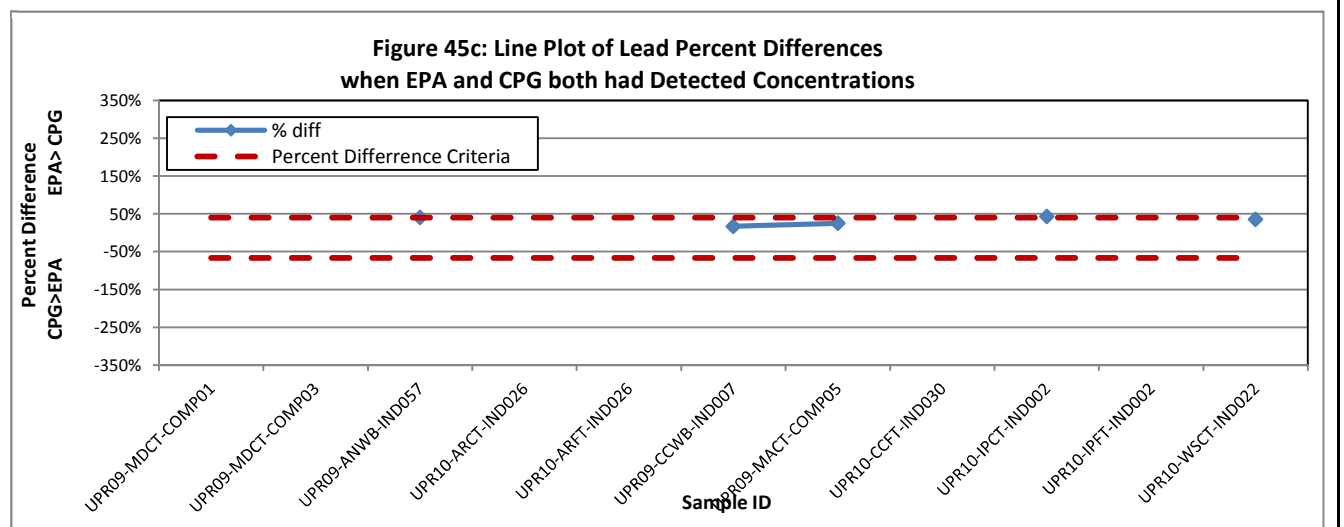
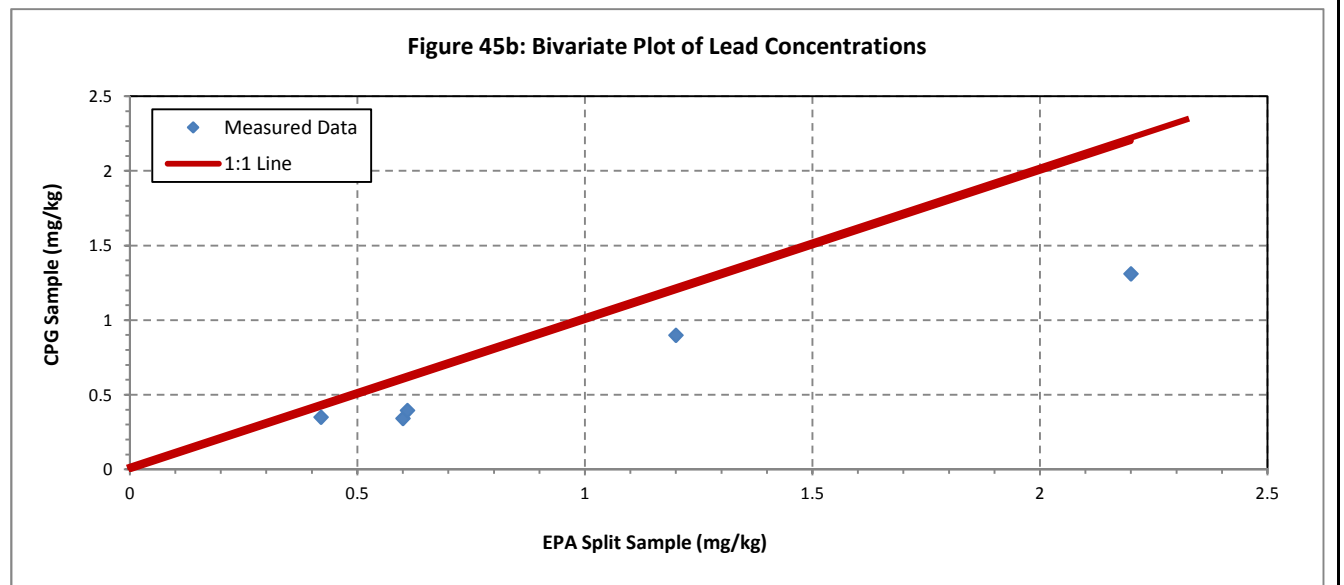
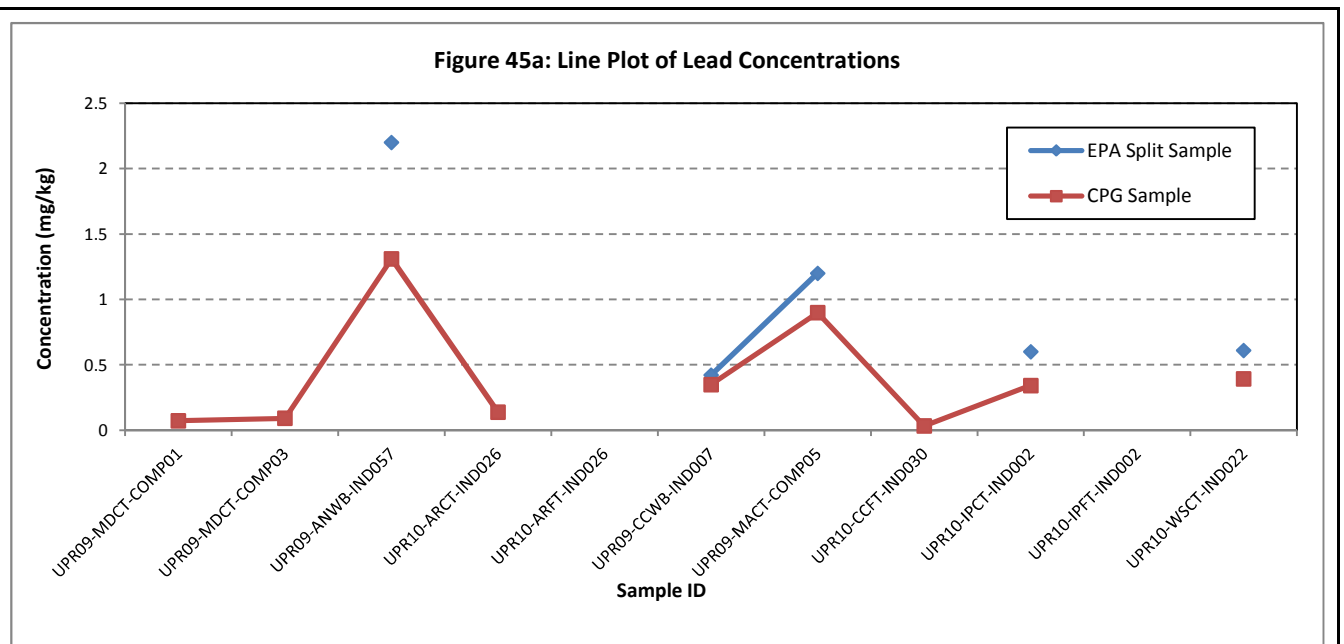


Figure 46a: Line Plot of Nickel Concentrations

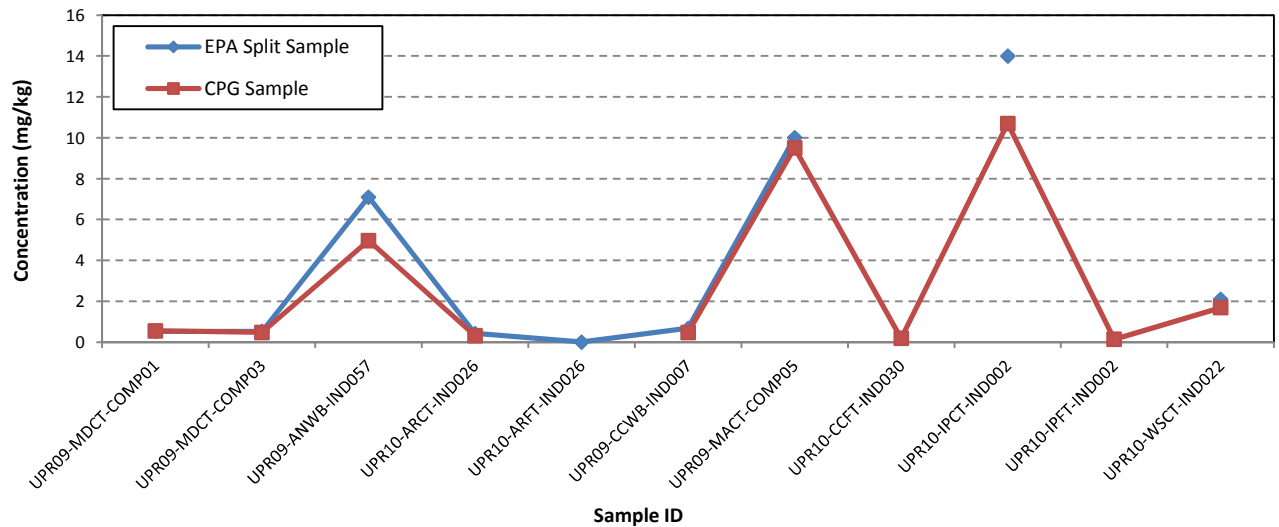


Figure 46b: Bivariate Plot of Nickel Concentrations

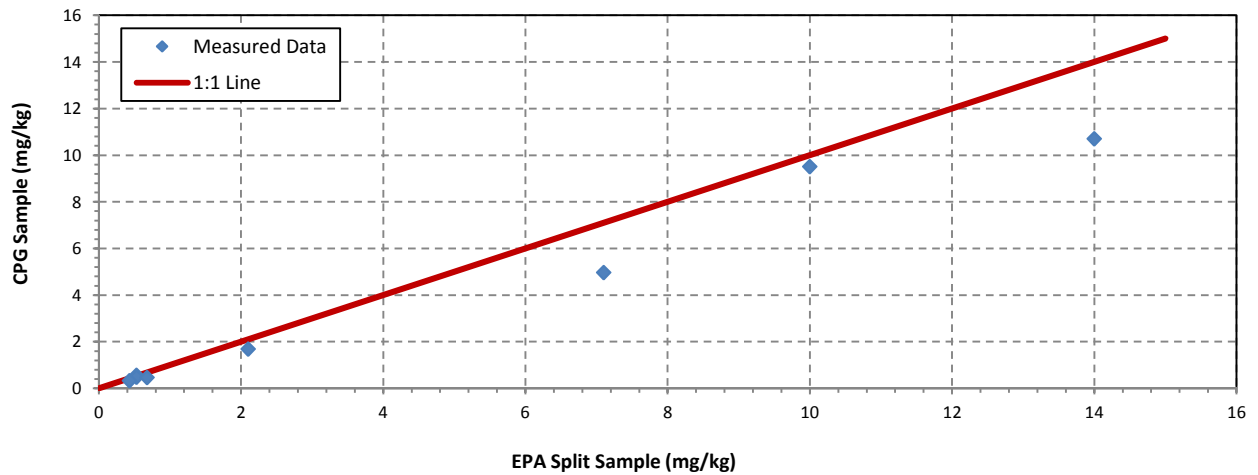


Figure 46c: Line Plot of Nickel Percent Differences when EPA and CPG both had Detected Concentrations

